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ANNALS *of* SURGERY

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EPITHELIOMA IMMEDIATELY FOLLOWING SINGLE BURN

BY THOMAS R. CHAMBERS, M.D.
OF BALTIMORE, MD.

THE case herein reported is considered worthy of being placed on record because of the rarity of such occurrences, and because of the bearing such cases have on the question of the etiological factors in the development of cancer. The history of the case follows, with a brief review of the literature bearing on the subject.

The patient, F. C., male, American, aged fifty-five, fireman in steam laundry, came under our care on February 3, 1916, with the following interesting history. Complaint: Sore on right wrist.

Past History.—Negative. Has never had injury or any type of lesion on right wrist, excepting present condition.

Present Illness.—Four weeks ago patient, while shovelling coal into furnace, touched back of right wrist against side of furnace door, causing a rather deep and painful burn. Has been treating same at home, but as wound apparently will not heal, comes for treatment.

Physical Examination.—Situated on dorsum of right hand at base of thumb in anatomical "snuff box," there is a small irregular raised tumor about 2.5 × 2 cm. This tumor is ulcerated in the centre with a slight semi-purulent discharge. The growth seems to be a part of the true skin and can be moved freely over the underlying structures. Its general appearance resembles very much the so-called pipe-smoker's cancer, or epithelioma of lower lip. At time when first seen by us there was no pain associated with the growth. No lymphatic glands involved.

Diagnosis.—Epithelioma. Excision advised.

Treatment.—Iodine technic under local anæsthesia. Growth and fair margin of surrounding apparently normal tissue excised. Wound sutured.

Pathological Report (by Dr. Standish McCleary, Path. Lab. Col. of P. and S., Baltimore).—The tissue is 2 cm. long by 1 deep. It consists of skin and a slight amount of subcutaneous tissue. The surface is covered with stratified squamous epithelium which on the margins is somewhat thickened. In the middle the epithelium is quite thin and consists of only the upper layers of the normal epidermis, the basal and prickle-cells being absent. Where the attenuated epidermis is confluent with the thicker portion an invasion of the underlying dermis is plainly seen. The dermis is infiltrated by columns of epithelial cells and contains typical "cancer nests" surrounded by a stroma rich in fibroblastic elements and round-cells. These nests extend as deep as the lowest sweat-glands. The epithelial cells in these nests are typical, both in appearance and arrangement of squamous-cell epithelioma. In the larger nests the basal cells are at the periphery, next come the prickle-cells with the spines well shown, and "pearls" are to be seen in these larger nests. There is a well defined layer of sound tissue beneath the invading growth and the margins include uninvolved tissue, so that it would appear that the growth has been entirely included in the tissue sent to me for examination. The specimen is a typical squamous-cell epithelioma.

The importance of preëxisting local conditions in the etiology of malignant growths has been much emphasized of late, and the significance of the so-called "precancerous lesion" is generally accepted. The literature is so rich in articles dealing with this general question that we shall confine our attempt now to a brief consideration of those papers dealing more or less directly with the relation between burns and the development of malignancy.

Coley,[1] who has made an extensive review of the literature up to 1910, on the relation between various forms of trauma and malignancy, reports 970 cases of sarcoma, of which 23 per cent. give a history of some form of trauma, and of these, 2 were traced to chemical burns, 1 was due to carbolic acid, and the other to the application of arsenical paste to a pigmented mole. It will be noted that no instance of thermic burn is found in this collection of cases. He also reports 250 cases of carcinoma with a history of trauma in 32.8 per cent., none of these having a burn as the etiological factor. There are several articles dealing with the occurrence in Kashmir of the so-called Kangri-burn cancer. Davis,[2] in a paper on paraffin cancer, quotes E. F. Neve,[3] who has reported 484 cases of this form of epithelioma. The growths are attributed to the constant application of heat to the abdomen and thighs of the natives of Kashmir, who carry the Kangri or portable fire-basket under their clothing for purposes of warmth. Davis suggests that the irritation of soot and gases from these stones may be as much a source of the resultant epithelioma as the heat. In any event the

FIG. 1.

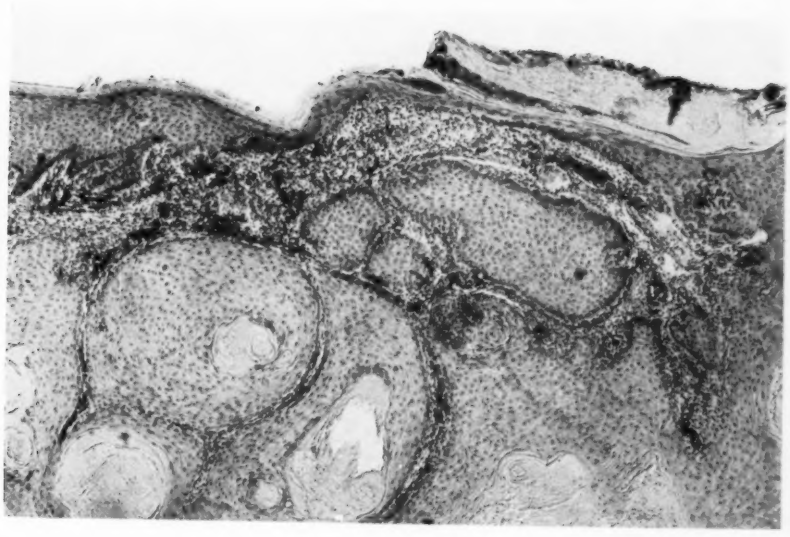
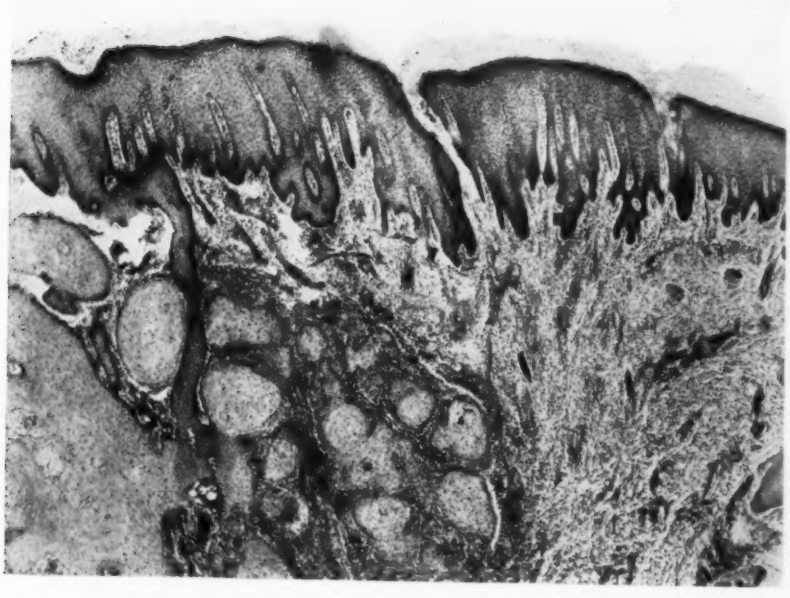


FIG. 2.



FIGS. 1 and 2.—Showing epidermal invasion of underlying dermis; also shows "cancer nests."

condition is one of long-continued and constant application of the local irritant, whereas the case here reported followed directly upon a single burn. In this same article by Davis, a case of paraffin cancer is reported and the literature on chemical irritation as a cause of cancer is reviewed. Da Costa [4] cites the case of an epithelioma arising in the cicatrix of a burn, but fails to state what interval elapsed between the burn and the development of the growth, or what type the burn was, or whether it had completely healed. Apparently the occurrence of cancer in brand-scars in animals is not exceedingly rare, as Cleland [5] reports such a case, the growth developing in the scar many years after the branding. In text-books of surgery, scars of old burns, as other scars in general, are noted as foci for the origin of malignant growths.

It is to be noted that no case that we have found reported presents the following features of this one: A growth following upon a single thermic burn, of structures apparently previously healthy, the development of the growth taking place within less than a month of the burn, without the healing of the original lesion.

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[3] Neve, E. F.: Brit. Med. Jour., 1910, 11, 589.
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TOTAL BONE GRAFTS INTO SKULL DEFECTS *

By Addison G. Brenizer
of Charlotte, N. C.

Viewed in the light of the results of experimentation and bone grafting done in man in the last few years, it is remarkable that so few cases of total autoplastic bone transplants into skull defects have been reported in the literature. Up to October, 1914, Rhodes [1] claimed that, so far as he could find, his four cases of large total graft into the cranium were the first to be reported. McWilliams [2] cites two cases reported by Paul Mueller [3] where pedicled sternum flaps were used to fill skull defects, but these operations were unnecessarily complicated for the reason that free grafts have been proven equally successful and that the pedicle offers little advantage in the establishment of a new blood supply to the graft. McWilliams mentions a case of Schroeder where he transplanted a piece of the scapula into the skull, also a case of Tomita where he transplanted a piece of tibia with periosteum into the skull, and finally quotes Funke [4] who says that in all small defects of the skull the autoplastic graft is to be preferred above all other methods. There may be other cases, but I have not found a report of them.

This paucity of reports is all the more remarkable when the ease of execution of the grafting, as compared with grafting in other parts, is considered. With the aid of a set of modern bone instruments like those of Dr. Charles Geiger (Fig. 1), allowing the cutting of bone shells, inlays, wedges and nails, almost any required bone transplant may be fashioned in size and shape to fit a given defect in the skull; the defect in the skull may also be fashioned to help fit the transplant. Moreover, the structural conditions for the reception, for the support in a fixed position and for the blood vascular supply are all good and favorable to the life of the grafted bone.

Defects in the skull show little spontaneous tendency to become filled with bone; they are filled with scar tissue, with little ingrowth of bone from the edges. This ingrowth from the edges is usually irregular and not under control, as is the case with defects in long bones. Both my cases to be cited directly were of six and fifteen years' duration, respectively, both had been previously trephined and both showed but little growth of new bone around the edges and that irregular. The same cases showed an even filling out with bone and a limiting at the site of the former periosteal periosteum at the location where the bone trans-

* Read before the North Carolina State Medical Society, May, 1916.

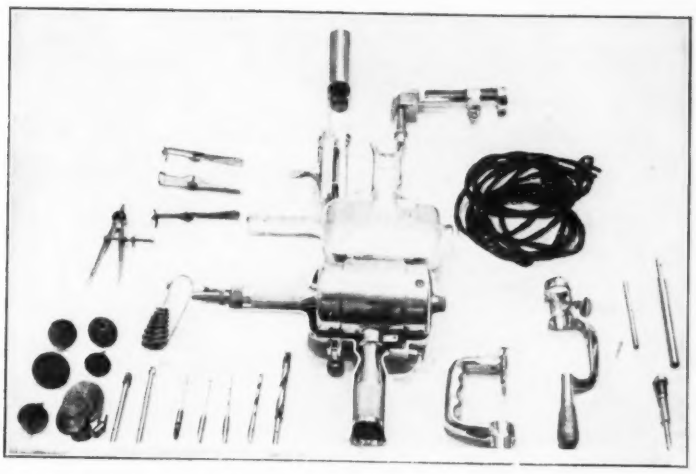

FIG. 1.—Some modern bone instruments showing a sterilizable motor and connecting cord, circular saws, twin saws, trephine, burrs, drills, spiral bone cutter, dowel cutter; with guards, lathe, etc., for the same. Every part can be sterilized by dry and moist heat. (Chas. Geiger.)

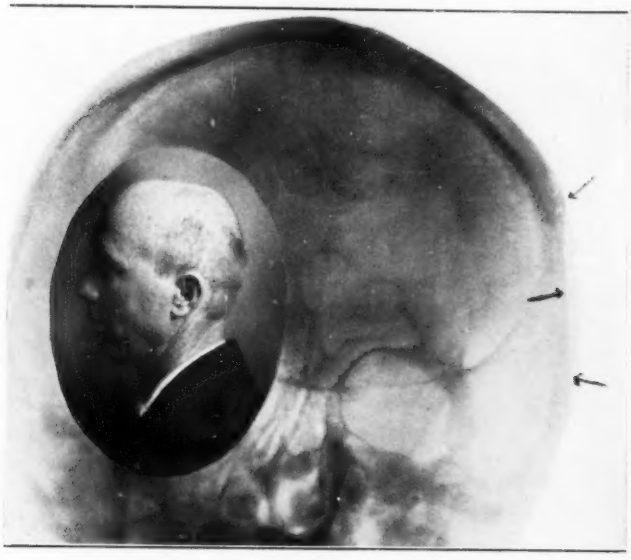

FIG. 2.—Case II. Six weeks after the operation and the site of the old skull defect filled in by the bone transplant. (Brenizer.)

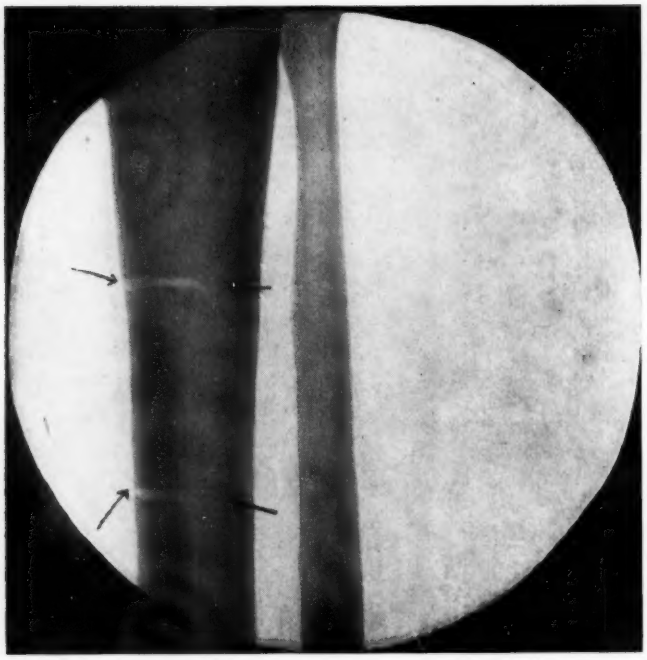

FIG. 3.—The site where the graft was taken from the left tibia. The origin of the graft is well filled in and smooth even after six weeks. (Brenizer.)

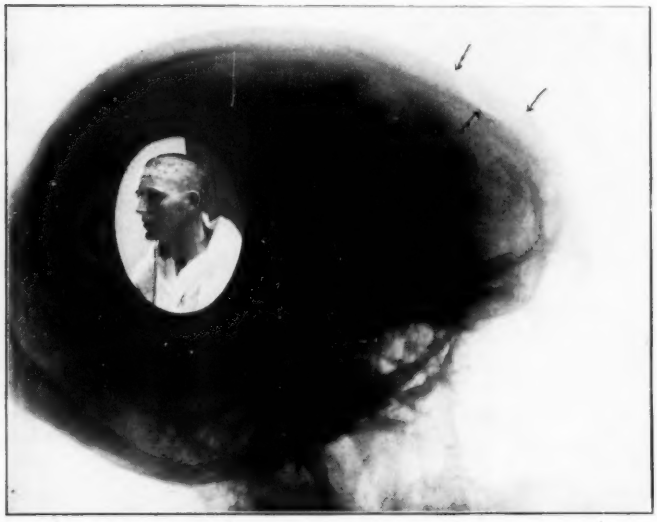

FIG. 4.—Case II. Two weeks after the operation, showing the site of the old skull defect filled in by the graft from the patient's left tibia. (Brenizer.)

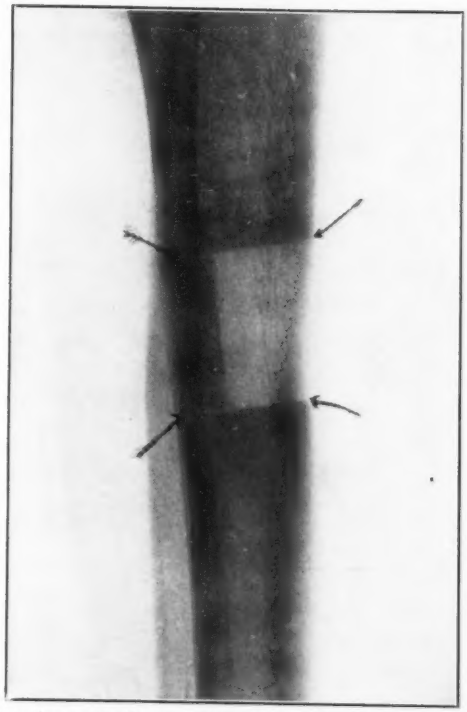

FIG. 5.—Showing location on the inner surface of the left tibia where the graft was taken. (Brenizer.)

plant was taken from the tibia. (I believe a new periosteum is formed from the bordering connective tissue and the underlying bone cells. But why this remarkable shaping and control of growth in the case of long bones and the failure in the case of the skull?)

The bone edges surrounding skull defects are stimulated to greater activity in new bone formation by celluloid plates, bones from other animals, and boiled and living bone from other individuals. Numerous such cases have been reported successful in the beginning, but the ultimate outcome has been left obscure in most cases. Funke [4] had one case of a celluloid plate which developed a sinus after ten years and at the second operation, at that time, he found the plate broken and the consistency changed. These plates never become completely surrounded by bone. Albee [5] claims that metal even inhibits bone formation, produces bone absorption and favors infection. "The bone graft apparently acts always as a stimulus to osteogenesis to the bone into which it is ingrafted or contacted" (Albee). "The inner layer of the periosteum, the endosteum, and, to a much less, if not negligible, extent, the lining of the haversian canals provide the cells for the osteogenesis in bone repair, to which may be added the comparatively few bone cells in the graft itself which survive" (McWilliams).

Both of these factors, (*a*) the stimulation of new bone formation in the surrounding bone through contact with the graft, and (*b*) the growth of new bone from the constituents of the graft itself, are of great importance in filling skull defects where the surrounding bone, otherwise, shows little tendency to spontaneously reform. The degree of difference of new bone formation in response to the stimulating graft on the part of the skull as compared with that of a long bone, I do not know; the growth of the grafted bone in both instances would be in no way inhibited.

"The graft should be living, free or pedunculated, with as much periosteum covering as possible and also containing endosteum and marrow, and the graft should be autogenous; that is, taken from the patient who is to be grafted. It seems certain that if the graft be made according to these rules nothing further is necessary to insure success, save the attainment of asepsis and the maintenance of immobilization" (McWilliams).

CASE I.—A man thirty-five years old, whose head was severely crushed in a railway accident six years previously. At this time the head was trephined and some bone splinters removed. Shortly after this he developed "spells" when he would lose consciousness and "spasms" mostly on the opposite side. Speech slow; apper-

ception dull. There was a large depression over the left side of the skull, the soft parts drawn down tight and the bone deficient over an area about 4 cm. by 6 cm. The soft parts were loosened up, the scar tissue removed, the callus around the edges cut away and the edges bevelled at the expense of the outer table. Into this defect was grafted a rectangular bone shell taken from the tibia, cut and bevelled to fit. A few stitches were placed to unite the periosteum of the graft with that of the skull, and the wound closed. The graft was covered with periosteum and was cut just to the marrow cavity. Fig. 2 shows a picture of the man six weeks after the operation and the site of the old skull defect filled by the bone transplant. Fig. 3 the site where the graft was taken from the left tibia. The origin of the graft is well filled in and smooth even after six weeks. The case was operated on about a year prior to date, and I heard from the man a few days ago that his head was well closed and that he had not had a "spell" in a number of months.

CASE II.—A man twenty-two years old, kicked in the head by a mule fifteen years previously. Some bone was removed, some came out from time to time, leaving his head sunken in. He formerly dragged the leg on the opposite side and dropped words. Had great deal of headache and pain over the depression. Head was trephined a year ago, symptoms better for a while, again worse. Depression and opening in skull about 3 cm. by 4 cm., the soft parts were drawn down and attached. The soft parts were liberated, scar tissue and callus removed, dura freed and the edges bevelled to receive the graft taken from the left tibia. Fig. 4 is a picture of the patient two weeks after the operation and of the site of the skull defect filled in by the graft, and Fig. 5 the location on the surface of the left tibia where the graft was taken. The man after four weeks reports himself improved.

The chances of fracture of the tibia after the removal of the graft are not very great if the patient takes reasonable care of his leg for a few weeks, as the area quickly becomes filled with bone and is made strong.

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[3] Mueller, Paul: Deckung von Schaedeldefekten aus dem Sternum. Zentralbl. f. Chirug., 1915, vlii, 409.

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PARTIAL EPIPHYSIAL TRANSPLANTATION FOR DEFECT IN FIBULA

REPORT OF CASE UNDER OBSERVATION OVER FIVE YEARS

By John Staige Davis, M.D.
of Baltimore, Md.

Introduction.—The recent appearance of an excellent paper by S. L. Haas,[1] on "The Experimental Transplantation of the Epiphysis, with Observations on the Longitudinal Growth of Bone," has prompted the report of this case of partial epiphysial transplantation.

Haas [2] gives a critical review of the experimental work on this subject. In his conclusions he finds that the epiphysial cartilage after transplantation degenerates and loses its power to functionate.

The results of clinical reports are analyzed in an article by Jost,[3] who says that the few clinical cases on record have not been under observation for a sufficient length of time to determine whether the transplanted epiphysis will survive and functionate, or whether it will die.

I have been unable to find in the literature a case which had been observed for longer than a few months, so it seems worth while to report the following case, which has been under observation for over five years.

If any conclusion can be drawn from the observation of one case, this length of time will undoubtedly have been sufficient for the permanent changes to have taken place.

---

[1] Haas, S. L.: Jour. Amer. Med. Ass., December 4, 1915, p. 1965.

[2] As there were no isotransplants in Dr. Haas's series, I will outline a group of experiments which I carried out in the fall of 1911. Fifteen isotransplantations were done on dogs. One-half and one-third joints with the corresponding portion of the epiphysial cartilage and adjacent sections of the shaft from 1.5 to 3.5 cm. long were transplanted. The animals were of about the same size and age, and the distal extremity of the radius was used in each instance. The time elapsing between operation and examination of the specimens was from 73 to 141 days. In each experiment absorption was noted in the transplant, with degeneration of the epiphysial cartilage, and subsequent shortening of the bone and deformity on that side. These experiments were checked by X-ray before and after operation. The conclusion might be drawn that the transplantation of isoepiphyses is hardly worth trying clinically.

[3] Jost, O.: Beitrage zur Osteoplastik an den Extremitaten, mit besonderer Berucksichtigung des Verhaltens der Epiphyse. Beitr. z. klin. Chir., 1915, Bd. 95, p. 116.

CASE REPORT.—I. S., a white boy, ten years old, in the Crippled Children's Hospital, was referred to me by Dr. R. Tunstall Taylor. Two years previously his left leg and foot had been badly mangled by an electric car.

Examination (March 20, 1911).—The much mutilated foot was at right angles to the leg, but was markedly everted.[4] The outer portion of the lower half of the leg and foot was covered with a dense, tightly adherent scar. There was practically no motion of the ankle-joint in any direction. The lower fourth of the fibula was lacking, and the stump could be felt through the scar. There was marked outward bowing of the tibia.

Measurements: Right calf, 27 cm.; left calf, 22 cm.; right tibia, 29 cm.; left tibia, 28 cm.; right fibula, 29 cm.; left fibula 22 cm.

X-ray showed the stump of the fibula to be somewhat thickened above and terminating in a sharp spicule of bone.[5]

There had also been destruction of the outer portion of the tibia adjacent to the fibula defect, as well as about one-fourth of the articulating surface, with a corresponding portion of the epiphysial cartilage above.[6]

Operation (March 27, 1911).—Ether anæsthesia. The stump of the fibula was exposed; the periosteum was stripped back and a portion of the tip was removed. A channel was made in the scar tissue from the end of the stump to the outer side of the astragalus, which corresponded as closely as possible to the original bed of the fibula.

The upper extremity of the left fibula was then exposed and split longitudinally, so that a section of bone 6 cm. long was removed, including about one-third of the thickness of the shaft with its periosteum, and a similar thickness of the upper extremity with its epiphysial cartilage. This was accomplished with some difficulty on account of the proximity of the peroneal nerve. The wound was closed. The transplant was then placed in the channel prepared for it, with its marrow surface toward the tibia. The upper end of the transplant and the stump of the fibula were held in approximation by a cuff of fascia removed from the upper

[4] Before the patient came under my care several attempts had been made to correct the deformity by excision of scar tissue, and by the use of plaster cases.

[5] A comparison of this picture taken two years after the accident with one taken four months after the accident showed remarkably little gain in the length of the stump during that time.

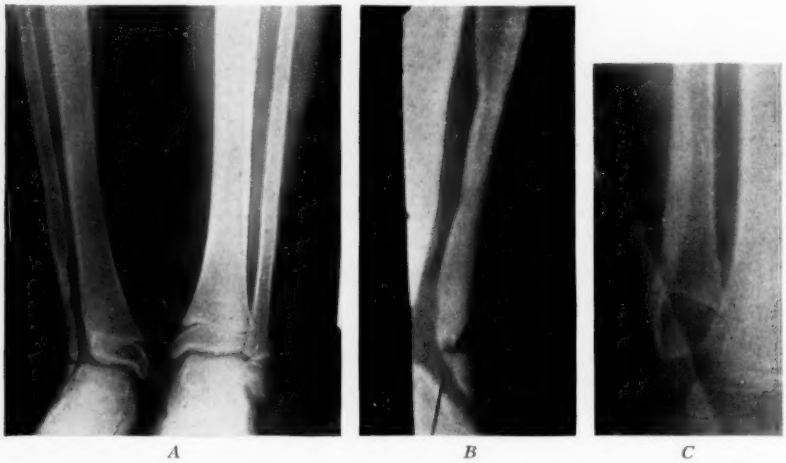
[6] The question arose as to the best procedure to prevent further eversion of the foot. Bone transplantation suggested itself, and it occurred to me that bone with epiphysial cartilage might be of some advantage (in a growing boy), should it turn out that the function of the transplanted epiphysis be preserved.

A *B*

FIG. 1.—July 28, 1909. *A*, X-ray taken four months after accident. *B*, taken before first operation. Note the amount of new bone formation and its small size when compared with the shaft of the fibula.

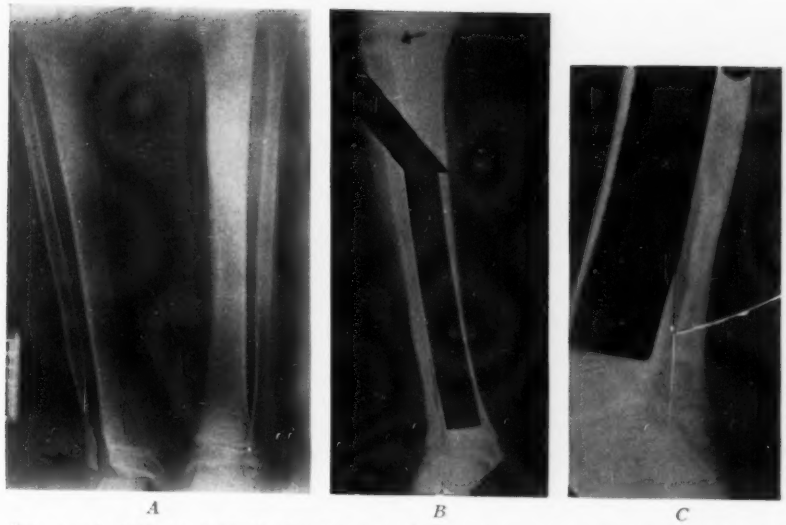
A B

FIG. 2.—September 6, 1911. *A*, there is atrophy of the bones, probably due to the long continued plaster fixation. The graft has united completely with the shaft. The arrow shows the point of junction. The notch 2 cm. below the upper extremity of the transplant is due to uneven cutting when the fibula was split. The epiphysis seems in good condition, and is bent slightly outward. *B* shows lateral view of the transplant.



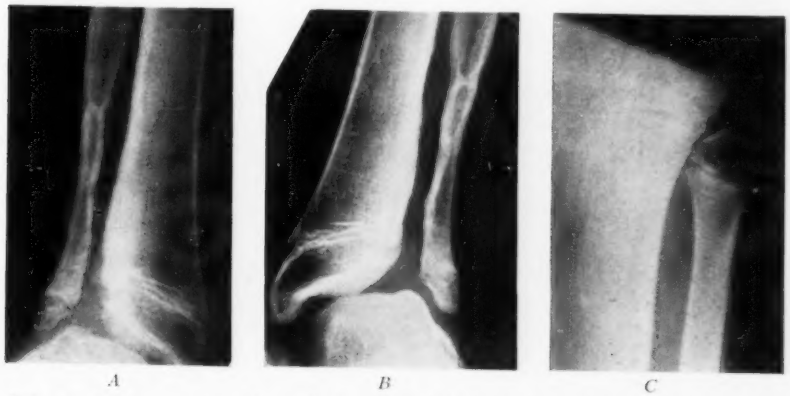
A B C

FIG. 3.—December 16, 1911. *A*, there is continued new bone formation. The epiphysis is throwing down bone. A small isolated piece of bone can be seen between the epiphysis and diaphysis, and probably is a small living fragment which did not appear in the previous plate. The graft is in good condition. *B*, February 24, 1912, bone production continues. The disparity between the thickness of the graft and the size of the fibula is diminishing. The medullary canal is beginning to develop in the graft. Cortical bone is being laid down irregularly. The lower epiphysis is developing proportionately. *C*, the upper epiphysis is in good condition.



A B C

FIG. 4.—*A*, May 24, 1912, the development of the medullary canal continues slowly. There is no cancellous bone at present in the diaphysial part of the graft. The epiphysis is apparently still in good condition. *B* and *C*, December 28, 1912, a trace of cancellous bone is seen in the diaphysial part of the graft. The small fragment seen in previous plates is united to the diaphysis. The epiphysis is developing slowly. The upper epiphysial cartilage is still in good condition. Unfortunately this plate was broken.



A B C

FIG. 5.—*A*, May 10, 1913, the grafted portion of the bone, while thin, begins to appear quite normal. The lower epiphysial line is not so sharply defined. At point of junction the medullary cavity is walled off. *B*, February 14, 1914, the epiphysial line is present, but shows distinct beginning ossification to diaphysis. The medullary canal of the graft is still walled off from that of the shaft of the fibula. *C*, the upper epiphysial line is in good condition.

A *B* *C*

FIG. 6.—*A*, November 6, 1915, ossification of the lower epiphysis is almost complete, and further advanced than the normal epiphysis on the opposite fibula. The medullary canal of graft and shaft have joined. The upper epiphysial line is intact and seems to have been little affected by the removal of the graft. *B*, March 25, 1916, the epiphysial line of the transplant still throws a faint shadow, but the ossification is practically complete. The ossification of the epiphysial line in the tibia is much further advanced than it was in *A*. There seems to have been a marked increase in the size of the transplant in the last few months, as it now more nearly approaches the size of the normal fibula. The medullary canal is more nearly normal in size, and the cortical bone is thicker. *C*, the upper epiphysial line is apparently normal, and shows that little if any damage was done by removing the transplant.

FIG. 7.—Photograph and X-ray taken March 25, 1916. Note the extent of eversion of the foot.

wound, and the epiphysial end was held in the position of the external malleolus by a band of free fascia, which was securely sutured to the astragalus. It was found impossible to close the scar tissue over the transplant, so in order to fill the defect and cover the transplant, a free graft of whole thickness skin, with a thin layer of fat, was obtained from the thigh. This graft was held in position with interrupted sutures. The wounds were dressed with silver foil and gauze, over which was placed a plaster cast.

April 17, 1911: First dressing. The sutured wounds had healed *per primam*. The superficial layers of the skin graft were doubtful, and were subsequently removed, but enough retained its vitality to entirely cover the transplanted bone. The convalescence was uninterrupted. The leg was kept in a removable plaster cast, and the patient was up and about on crutches.

June 27, 1911: The continuity of the fibula was unbroken. There was still eversion of the foot, but not as marked as before operation. There was very limited motion of the ankle-joint. Crutches were discontinued.

December 16, 1911: The motion of the ankle-joint was much improved. The boy walked and ran without difficulty. The foot was still everted, but there seemed to be no tendency to further eversion. In order to give more protection to the leg a short brace was ordered, allowing flexion and extension.

December 28, 1912: The patient still wore his brace while at school. The eversion was less noticeable. Flexion of the foot was perfect. Extension was somewhat limited. The outward bowing of the tibia had disappeared.

May 10, 1913: There was slight lateral motion in addition to flexion and improved extension.

February 14, 1914: Condition was excellent. The joint motion was improved.

March 20, 1915: The brace was worn only occasionally. There was no pain in the ankle-joint, and there was no tendency to further eversion. The functional result was good.

November 6, 1915: There was no tendency to further eversion. Flexion and extension were nearly normal. There was also increase of lateral motion.

March 25, 1916: The result after five years was a useful, functional ankle, with practically normal movement. There was comparatively little shortening. There was no tendency to further eversion.

July 8, 1916: The patient was in excellent condition. The motion of the joint was the same as at last note. There was

slightly more eversion of the foot, which may be due to the fact that the left tibia was increasing in length more rapidly than the fibula. During the last eight months the tibia had increased in length 2 cm., while the fibula had gained only .25 cm.

The following measurements, taken at various times, will be considered in a group:

	Right tibia cm.	Left tibia cm.	Right fibula cm.	Left fibula cm.
Before operation	29	28	29	22
July 27, 1911	29	28	29	28
Dec. 16, 1911	30	29	30	29
Dec. 28, 1912	32	31	31	29
May 10, 1913	32.5	31.3	32	29
Feb. 14, 1914	32.5	32	32	29.75
Mar. 20, 1915	34	33	33	31.5
Nov. 6, 1915	35	33	34.5	32.5
Mar. 25, 1916	35.5	34	35.5	32.75
July 8, 1916	36.5	35	36	32.75

Before operation the right tibia measured 29 cm. and the left tibia 28 cm. This difference of 1 cm. can be accounted for by the lack of use of the left leg, and possibly injury to the lower epiphysis. The difference in the lengths of the fibulæ of 7 cm. was due to the destruction of the lower portion of the left fibula.

The measurements taken four months after operation were the same as before operation, except that there was a gain of 6 cm. in the left fibula, which can be accounted for by the transplanted bone. During the next five months there was a gain of 1 cm. in both tibiæ, and of 1 cm. in each fibula.

The succeeding sixteen months showed a gain of 2.5 cm. for the right tibia; 2.3 cm. for the left; 2 cm. for the right fibula, and no gain for the left.

The measurements during the following nine months were unchanged, except for a gain of .7 cm. in the left tibia, and of .75 cm. in the left fibula. Thirteen months later there was a gain of 1.5 cm. in the right tibia; 1 cm. in the left; 1 cm. in the right fibula, and 1.75 cm. in the left. The following seven and a half months showed a gain of 1 cm. for the right tibia, and 1.2 cm. for the right fibula. The left tibia remained unchanged and the left fibula gained 1 cm.

During the succeeding eight and a half months there was a gain of 1.5 cm. in the right tibia, and 2 cm. in the left tibia; of 1.5 cm. in the right fibula, and of only .25 cm. in the left fibula. In short, since operation there was a gain of 7.5 cm. in the right tibia, and 7 cm. in the right fibula. There was a gain of 7 cm. in the left tibia, and 10.75 cm. in the left fibula.

A series of X-ray plates was taken at irregular intervals, during the period in which the patient had been under observation since the operation.[1] The plates seem to show that the graft had taken in toto.

Three years after transplantation the epiphysial line was still present, although there was distinct beginning ossification. This ossification gradually increased and five years after transplantation it was complete. The ossification was much further advanced than in the normal epiphysis on the opposite fibula. It was also much further advanced in ossification than was the epiphysial line of the upper extremity of the same fibula from which it was taken. The upper extremity of the left fibula was somewhat flattened laterally, but the epiphysial line seemed to have suffered no permanent harm by the removal of the transplant, and was apparently in normal condition when compared with the upper epiphysis of the right fibula. New bone had been laid down and a medullary canal had been formed, which had finally united with that of the shaft of the fibula. The transplant had gradually increased in thickness, both in its diaphysial and epiphysial portions, but even after five years had not attained quite the size of the normal shaft of the fibula.

Unfortunately no attempt was made to have the X-ray plates taken so that exact measurements could be made of the transplanted bone from time to time. However, it is interesting to note that there was an increase in the length of the transplant as measured on the plates taken September 6, 1911, and on March 25, 1916, of only 1 cm. thus leaving a gain of 3.75 cm. in the length of the fibula, in addition to the 6 cm. of the transplant, to be accounted for.

This apparently shows that there was less than one-fourth of the gain in length due to the transplanted epiphysial cartilage, in spite of the fact that the transplanted epiphysial cartilage seemed to survive for so long a period.

Comment.—The case is of interest when we bear in mind that there was successful transplantation of bone and epiphysial cartilage, free fascia bands and whole thickness skin, in spite of the fact that the circulation of the scar tissue into which they were transplanted was very poor.

The question arises as to whether the gain of 4.75 cm. in addition to the 6 cm. of the transplant, in the length of the left fibula, up to July 8, 1916, was caused by growth of bone originating from the trans-

[1] The plates taken two months after the operation and those taken March 20, 1915, were mislaid.

planted epiphysial cartilage, or whether it came from the epiphysial cartilage at the upper extremity of the bone, or from both.

My experimental experience has been that when either extremity of a long bone, including a portion of the diaphysis and the adjacent epiphysis with periosteum, has been removed, there is only an insignificant attempt to fill out the defect, either from the remaining epiphysis or from the stump.

Friederich (quoted by O. Jost, *Beitr. z. klin. Chir.*, 1915, Bd. 95, p. 117) says that after resection of an epiphysial cartilage, the other epiphysis of the same bone can take care of the longitudinal growth. In considering this case we have had destruction of a large section of bone, in addition to the epiphysial cartilage. However, the insertion of the transplant into the defect in the fibula may have produced a condition somewhat similar to that caused by resection of the epiphysial cartilage, and thus have placed this case in the class of cases mentioned by Friederich.

The fusing of the transplanted epiphysis before the time usually assigned for either the upper or lower fibular epiphysis normally to unite to the diaphysis might have been due to the poor blood supply in its new bed; to trauma suffered in the course of transplantation, and also constantly occurring in its new position. The ossification of the left lower tibial epiphysial cartilage was also much further advanced than that of the right tibia, and this might have been due in part to the original injury and also the long-continued fixation and lack of use.

It is impossible to determine definitely from the study of this case whether the transplanted epiphysial cartilage exercised its normal function at all. There was only a very small gain in the length of the transplant in five years, and this gain was considerably less than the total gain in the length of bone.

The upper epiphysis probably has been the marked factor in the increase in length of the left fibula. Considering the time which elapsed before the ossification of the transplanted epiphysial cartilage and the continued steady increase in size, both in the diaphysial and epiphysial portions of the transplant, it seems possible that the transplanted epiphysis might have also had, for a time at least, a small share in adding to the length of the fibula.

VENOUS ANEURISMAL VARIX

By W. H. Axtell, M.D.
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In this variety the aneurismal sac is located in the vein itself, and the artery communicates with the vein directly and, through its pulsations, is responsible for the sacculation of the vein. This variety is quite rare, this being the only case met with in a practice of twenty-five years.

Fig. 1.—*a*, communicating artery; *b*, venous aneurism; *c*, coiled varicose veins (actual size) (author's case).

In the other variety the artery communicates with the vein only after adhesions have formed between them as a result of varicosity and imflammatory conditions. This variety is frequently met with, but the sacculation is usually present in both the vein and artery or else there is an intervening sac, through which the arterial blood passes to the vein.

This case occurred in a rugged, healthy and athletic young man twenty-six years of age. For several years he had noticed an enlargement of the inner aspect of the right knee—sometimes quite distinct, then at times the enlargement would apparently disappear. During the past two years, however, the enlargement remained and, quite frequently, would become so inflamed and tender that he would be incapacitated. This was the condition present when he came to me for advice. Examination at once revealed the true condition, although no distinct bruit or thrill could be detected in the aneurismal sac. The pulsation of the artery, however, could be readily felt. The internal long saphenous vein was involved where it crosses the knee.

February 19, 1916, under local anæsthesia, the varicose vein was removed and the artery ligated. The accompanying drawing (Fig. 1) shows the specimen in detail and is self-explanatory. It was not till the eighth day, after the removal of the first dressing, that I discovered the possible cause may have been lues—there had been not the slightest effort at union of the skin, which promptly occurred after large doses of kali. He previously denied any specific ailment.

His mother and two married sisters had varicose veins of the legs during pregnancy and following confinements.

SEGMENTAL RESECTION FOR GASTRIC ULCER*

A PRELIMINARY REPORT BASED UPON CLINICAL AND EXPERIMENTAL STUDIES

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The problem has arisen in the treatment of gastric ulcer whether the removal of the ulcer-bearing site, which is commonly a saddle-shaped section from the lesser curvature of the pyloric region, or whether the resection of the ulcer-bearing segment is associated with the better post-operative motility. Given an excision operation that has been performed perfectly, technically, its success obviously depends upon the tonus and upon the contractions of the remaining stomach. Moynihan, Von Eiselsberg, and Mayo have called attention to the functional impairment following certain of these operations. W. J. Mayo, in his recent discussion of the surgery of ulcer at San Francisco, declared "the sleeve resection . . . gives an excellent permanent result. . . . Just why this operation, in which the corresponding part of the greater curvature is removed at the time the ulcer is excised, should leave the stomach with good motility while excision of the ulcer without removal of the segment of the greater curvature of the stomach leaves it with poor motility is an interesting conjecture." [1]

The radical operations for gastric ulcer have been

1. Simple excision with knife or cautery.
2. Simple excision with gastro-enterostomy added.
3. Simple excision with gastro-enterostomy and pyloric occlusion.
4. Pylorectomy and partial gastrectomy with some form of gastro-enterostomy.
5. Resection of the ulcer-bearing segment of the stomach ("sleeve" or segmental resection) with or without gastro-enterostomy.

The palliative measures have been the gastro-plastics and gastro-enterostomies alone or combined with the turning in or the strangulation of the ulcerous areas. Bloodgood, W. J. Mayo, Smithies and Ochsner have emphasized the tendency of gastric ulcer to become malignant. Patterson, of London, and others believe that comparatively few of the ulcers of the stomach develop into cancer. The present tendency of surgeons, however, is to treat ulcer as potential carcinoma and

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to add to whatever palliative measure has been adopted excision of the ulcer, thus lessening the possibilities of malignant degeneration.

Briefly, the indication for segmental gastrectomy is the large calloused ulceration. The technic consists in removing a segment of the stomach containing the lesion and in uniting terminally the divided ends. It calls for the removal of more tissues than that immediately involved in the ulcer but less usually than in pylorectomy. For the purposes of studying the motility of the stomach following the excision of the "cuff," the segmental method has been correlated with that of excision of the ulcerous area or "triangular" gastrectomy.

Several segmental resections have been performed.

Of the four cases presented, the first, second, and fourth have had complete gastric segments removed; the third, the ulceration, alone.

CASE I.—J. H., admitted November 29, discharged December 31, 1915, sixty-three years of age, and born in United States of America. Occupation, watchman.

Family history irrelevant. Had rheumatism and venereal infections. Uses tobacco and alcohol. For the past two years attacks of vomiting and abdominal pain. Eructates gas and fluid. Has lost appetite and weight. Urine negative. Blood shows 5,696,000 reds with 80 per cent. hæmoglobin and 10,000 leucocytes with 79 per cent. polynuclears. Wassermann negative. Gastric analysis gives a total acidity of 85 and a free acidity of 54.5 with no blood, Boas-Oppler bacilli or sarcinæ.

Operation (December 4, 1915).—By Doctor Stewart. Removed a 2-inch segment of stomach bearing an ulcer of lesser curvature. Ends of completely divided stomach approximated by an inner chromic and an outer Pagenstecher suture. Cigarette drain left in the lesser sac of peritoneum. Uneventful recovery.

CASE II.—N. M., admitted January 6, discharged February 4, 1916, twenty-nine years of age and born in Austria. Occupation, motorman.

Family history negative. Uses tobacco, habits and past otherwise negative. For the past 7 months attacks of nausea and epigastric burning or pain. Pain relieved by eating. Appetite good until just prior to entrance. Loss in weight slight (2–3 lbs.). Epigastric tenderness. Urine negative. Gastric analysis gives 54 c.c. of total and 6 c.c. of free acid, with no blood or lactic acid. Wassermann negative.

Operation.—By Doctor Stewart. Removed ulcer-bearing segment and performed gastro-gastrorrhaphy as in above case. Uneventful recovery.

CASE III.—M. F. D., admitted November, discharged December 29, 1915, forty-six years of age, and born in United States of America, occupation, clergyman.

Family and past history irrelevant. For the past fifteen years eructation of burning fluid. For the past 3 months vomiting attacks. Has no abdominal pain. No masses, tenderness, or rigidity in abdomen. Urine negative. Blood shows 7800 leucocytes with 79 polynuclears. Gastric analysis gives a total acidity of .06 and a free acid of .08 with no blood or lactic acid. Wassermann negative.

Operation (December 13, 1916).—By Doctor Stewart. Ulcer of lesser curvature of stomach near œsophagus removed. Opening closed with inner chromic and outer Pagenstecher sutures. Two cigarette drains left in. Uneventful recovery.

CASE IV.—A. L., admitted March 28, discharged April 18, 1916, sixty-six years of age, and born in United States of America, occupation housewife.

Family and past history irrelevant. For the past 2 years nausea, losses in weight and in strength. Tender stomach mass distinctly palpable. Urine negative. Gastric analysis shows absence of free hydrochloric acid and no blood or lactic acid.

Operation (March 29, 1916).—By Doctor Barber. Adenocarcinoma of the body of the stomach resected and divided ends reunited by inner chromic and outer Pagenstecher. Uneventful recovery.†

The X-rays of all the above have been studied and are given below.

In attempting an experimental study of the motility of the stomach after segmental resection, it seemed wise, first, to review, briefly, the known muscle physiology of the normal stomach and, then, to compare the movements of the resected stomachs. These movements were observed directly before and after the removal of triangles and segments from the stomach walls, and indirectly through the tracings of changes in the intragastric pressure as well as through repeated X-ray findings of normal stomachs and of stomachs after resection.

It is generally agreed that (1) normal gastric prostalsis begins in the fundus in the vicinity of the cardia, that (2) the stomach is tonic and contracts peristaltically, that (3) this tone and these contractions are subject to certain influences, such as the general health of the individual, the contents of the stomach, the presence, or absence of irritable foci, the quality and the quantity of the blood supply, and stimuli from the vagus and splanchnic nerves, and that (4) normal prostaltic contractions which begin in the fundic portion terminate in the pyloric end of the stomach.

†This case is reported under Tumors of the Stomach, Ref. Handbook Med. Sciences, 1916, and is reported here because of its being a most recent segmental resection. Note the preservation of four-hour emptying two weeks postoperative.

The locus of origin of the individual contractions is not (to our knowledge) definitely established. From inspection of the dogs' stomachs under light ether narcosis, it appears to fall on a point, approximately, half-way down the descending arm of the lesser curvature. By different methods, Beaumont,[2] Brinton,[2] Becterew and Mislawski [3] placed the initial contractions at the cardia; Hofmeister and Schütz, "near the cardia;" and Auer [4] " near the œsophageal insertion." It is probable that the contraction actually starts at the cardia but does not become recognizable, macroscopically, until it involves the anterior face of the stomach a short distance distal to the cardiac sphincter.

From this fundic site, the wave is observed to sweep toward a corresponding point on the greater curvature and caudad in successive cross-sections. As it progresses, it keeps fairly transverse to the long axis of the stomach while the rate on the greater curvature is greater than on the lesser. The anthral sphincter (three to four fingers' breadth above the pylorus) contracts most forcibly: at least it shows the greatest indentation perpendicularly when viewed anteroposterially, and the greatest constriction when examined stereoscopically. Cole [5] has estimated the rate of this gastric cycle in man at 2.5 cm. per second and the time at 2 to 25 seconds. Auer mentions an " angular section of the preantrum " which the peristaltic wave " apparently skips in its course " to the sphincter antri. Brinton's theory of the three streams of the active stomach—namely, one along the greater curvature toward the pylorus, one along the lesser curvature in the same direction, and a reversed medial current—is given added significance by the observations of the return of solid particles from the antrum to the body of the stomach and by the contributions of Jefferson, [9] A. Herz, [10] and Moritz, [11] in respect to the existence of a gastric stream which following the lesser curvature empties at the pylorus.

The reciprocal dependence of the stomach upon the health of the individual is well known. The medical student, worn out at the end of his school year, often finds delay in his stomach which ordinarily empties itself perfectly. This constitutional factor enters into the force of the stomach movements and manifests itself under the same conditions of life in some instances by atony and in others by hypermotility.

The stomach's activity varies periodically according to phases of digestion. The time immediately following a meal divides itself into periods of forcible contractions alternating with intervals of relative quiescence. As the time increases after a meal, the contractile periods increase in length, from 12 min. for the relatively powerful contractions

to 30 min. for the strong ones. The intervals of rest vary from 5 min. for man (Carlson [6]) to 1½ to 2½ hours for the dog (Boldireff [7]). Not only do the contractions of the oncoming activity phases increase in intensity, that is in amplitude and in frequency, but the terminal ones may end in tetanus. Carlson has drawn attention to a continuous rhythm of 20 sec. duration which he believes to spring from the pyloric musculature and to be always present. Both the 20 sec. rhythm and the more forcible stomach contractions disappear with health. According to Alvermann, [8] Rossbach and van Braam-Houckgeest denied that the empty stomach possessed characteristic movements but Hofmeister-Schütz, Moritz, and J. R. Ewald maintain that the same movements take place, only slower and fewer.

A common example of an irritable focus is the appendix in appendicular gastralgia. The stomach is the spokesman for many diseases located elsewhere, more or less remotely, in the alimentary canal. For a given period of health, in response to these stimuli, the stomach changes in the tone of the cardia which may become a cardiospasm, in the tone of the pylorus which may become a pylorospasm, possibly in the tone of the body of the organ which may be a true gastrospasm, and in the tone of the sphincters and the body, combined, which may be a true gastric tetany.

The quality of the blood, obviously, to some degree characterizes the stomach's activity. Carbon dioxogen may be an essential factor in stomach tonus. When increased in amount, it possibly may account for some of the instances of inexplicable acute dilatation of the stomach. The influence of asphyxia upon the gastric tonus is pointed out by Morat [12] in 1880, by Battelli [13] in 1896, and, probably, again, by the following experiment:

> An apparently normal dog is induced to swallow a rubber bag and tubing. The animal is put under light ether. The tubing is connected up with a tambour and chloroform manometer and through these with a kymograph. (The apparatus is similar, in principle, with that used by Morat in 1882, by Battelli in 1896, and Carlson at the present time). The contractions observed, under these conditions, are represented in tracings 3, 4, and 5. Note that decreased oxidation or asphyxiation is associated with intermittent contractions of short duration as compared with those of the normally aërated animal.

The influence of the extraneous nerves upon the automatic activity of the stomach has been demonstrated by Bayliss, Schütz, Unger, and others. Bayliss's [14] illustration of smooth muscle tonus by means of the " catch " mechanism is particularly suggestive.

Because of the relations of the vessels and nerves to the stomach's activity, many of the research studies in which these structures have

been disturbed necessarily present sources of error. That many of the involuntary activities do persist for a limited time in tissues removed from the body is well known, but that such manifestations are normal remains to be proved. In the following observations, it will be found that motor activities from the individual under mild ether corresponded fairly well with the kymographic tracings from the voluntary animal with the intragastric bag, and with the X-ray findings. The clinical studies compare favorably with these experimental data.

The dogs, times of operation, the operative proceedings, and the subsequent histories are tabulated in Table I. The " subsequent report "

TABLE I

Dog No.	Date of operation	Operation and operative observations	After-history
58	No record	Segmental resection; duodenostomy	No methylene blue from duodenal stoma 2 hr. 45 min.
77	January 13, 1916	Triangular resection	Traced 41 days later.
78	January 13, 1916	Resection of neuromuscular triangle	Traced 41 days later.
92	January 19, 1916	Triangular resection	Records incomplete.
93	January 19, 1916	Triangular resection	Etherized for morphological study; stomach *dilated.*
101	January 27, 1916	Resection of neuromuscular segment	Died 14 days later; intragastric hemorrhage; size of stomach *normal.*
103	January 27, 1916	Resection of neuromuscular segment	Died 15 days later; nephritis; stomach *contracted.*
115	February 3, 1916	Resection of neuromuscular segment	Died 37 days later; pneumonia; stomach *contracted.*
114	February 3, 1916	Segmental resection and fascial transplant	Traced 46 days later; X-rayed 41 and 42 days later.
127	February 10, 1916	Segmental resection; rate of prostaltic wave 20 sec. for 10.9 cm. or 1.83 cm. for 1 sec.	Traced 46 days later.
128	February 10, 1916	Segmental resection; time of prostaltic wave 21.7 sec.	Died 40 days later of pneumonia; stomach *moderately dilated.*
151	February 24, 1916	Segmental resection; time of prostaltic wave 11.4 sec. for 6.25 cm. or 1.8 cm. for 1 sec.	Traced 23 days later; X-rayed 21 and 22 days later.
152	February 24, 1916	Triangular resection; time of prostaltic wave 8.9 sec. for 2.5 cm. or 5/18 cm. for 1 sec.	Traced 25 days later; X-rayed 20 and 21 days later.
184	March 16, 1916	Triangular resection; time of prostaltic wave 14.7 sec.	Traced 30 days later.
206	March 30, 1916	Segmental resection	Died 27 days later; pneumonia; stomach *slightly dilated.*
233	April 13, 1916	Segmental resection	Traced 4 days later; 15 days later reported in good condition.

SUBSEQUENT REPORT BEARING UPON THE RELATION OF DILATATION OF THE STOMACH TO MECHANICAL CONSTRICTION AT THE SITE OF THE GASTRIC WOUND

Dog No.	Autopsy findings on April 20, 1916	Wave counts during stage of analgesia
114S	Size of stomach normal; size of resected portion admits two fingers	Cycles of av. 30.9 sec. duration.
151S	Stomach moderately dilated; resected portion admits one finger	Cycles of av. 20 sec. duration.
78T	Stomach markedly dilated; resected portion admits one fingertip	Died, apparently of malnutrition.
152T	Stomach moderately dilated; resected part admits two fingers	Died, apparently of malnutrition and of confinement.
184T	Stomach moderately dilated; resected part admits one finger	Cycles of av. 21.3 sec. duration.

S refers to segmentally resected dogs; T, to those with triangles removed. The animals do not do well under conditions of confinement within doors. For respective lengths of post-operative life, compare above chart.

reveals what mechanical obstruction, if present, were found in two segmentally and three triangularly resected dogs.

From this series, it appears that ten animals were examined post-mortem after two weeks to over two months of postoperative life. Of these, three were triangularly and seven segmentally resected dogs. The stomachs of the former were noted as "moderately" dilated in two and "markedly" in one; the stomachs of the latter as "normal" or "contracted" in four, "slightly" dilated in one, and "moderately" dilated in two. Furthermore (and this comparison is not to be given much importance because of the limited number of observations), the times of the prostaltic waves immediately following triangular gastrectomies were 8.9 sec. and 14.7 sec., respectively, and the rate (in one) $^{5}/_{18}$ cm. per sec.; after segmental gastrectomies, the times were 21.7 sec. and 11.4 sec., respectively, and the mean rate (in two) 1.8 cm. per sec. If these findings, taken in themselves, have any significance they represent the segmentally resected dog's stomach as the more motile during life and the more normal after death. The intercurrent affections are to be considered as contributing causes or more properly end-results of mortality in the above instances.

During the brief period of observation (immediately after anastomosis of the stomach ends and before closure of the abdomen) the waves seemed slower, shorter, and certainly less distinct in the animals with the triangles resected from the lesser curvature of the pylorus, and more rapid, more forcible, and longer in those with complete cuffs removed from the region of the pyloric incisura. In the former, the contractile wave was not recognizable until the region of the greatest contraction was reached, but in the latter the wave could be first seen at the mid-point on the descending arm of the lesser curvature. In both, the wave

was not traceable beyond the gastric wound and the pyloric end remained relaxed as well as amotile.

TABLE II

SHOWING RESULTS OF TRACINGS OF INTRAGASTRIC PRESSURE TECHNIC SIMILAR TO CARLSON'S

Dog No.	Time after eating	Forcible contraction	Continuous contraction and duration	Tonus changes
77T	1 hr.	Absent	Weak and 20–40 sec.	None observed.
78T	2½ hr.	Absent	Weak and 20–50 sec.	Present.
114S	20 min.	Present	10–20 sec.	Present.
127S	1 hr.	Present	Absent	None observed.
151S	2 hr. 20 min.	Present	10–20 sec.	Present.
152T	20 min.	Absent	15 sec.	None observed.
184T	25 min.	Absent	10–20 sec. and weak	None observed.
206S	(See Table I)			
233S	50 min.	Present	10–20 sec.	Present.

In Table No. 2 presenting the deductions from the tracings of eight dogs, each of the animals recorded was taken from a similar environment, fed a similar meal, and traced from 20 min. to 2 hr. 30 min. thereafter for periods ranging from 30 min. to 4 hr. The record, therefore, simply denotes what the stomach is doing with the bread and water meal for the short interval studied. It is seen that under these conditions, the animals with segments removed show forcible contractions and tonus changes and that the dogs with triangles resected generally do not. Both, however, give evidence of continuous rhythm. Under the conditions of laparotomy, the dog's stomach was observed to contract continuously (as pointed out above), presenting, in effect, a one- or two-cycle stomach. (Compare this picture with that of the normal dog with the bismuth-milk meal.)

It is evident that with an air-distended bag in the stomach contraction from any part of the gastric wall can influence the contained air—that is, the bag is not selective in its transmission of changes in intragastric pressure. The motility of the gastric segment aboral to the gastric wound is not differentiated. The tonic condition of the pyloric portion was noted at operation and its subsequent dynamic condition has been studied by the X-ray.

Röntgenographically, one normal and two pathological dogs and four pathological human cases have been reviewed. The findings are given below and explain themselves.

The normal dog (Fig. 5) shows a two-cycle stomach, a well-demarcated pyloric region, and a duodenal cap (dog No. 185). The stomach is practically free from bismuth (300 c.c. bismuth-milk emulsion) in

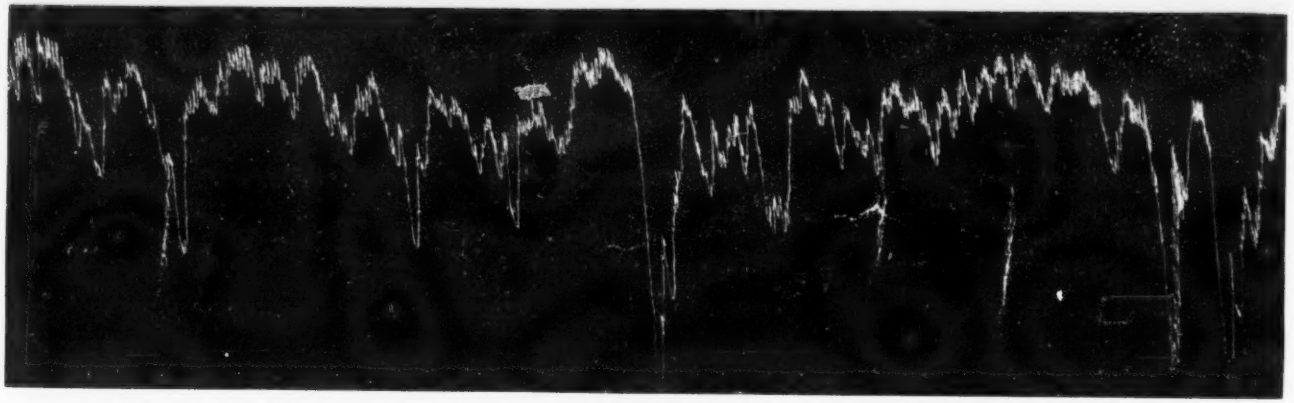


FIG. 1.—April 17, 1916. Dog No. 233 S. Traced 50 min. p.c. for one-half hour (portion of tracing).

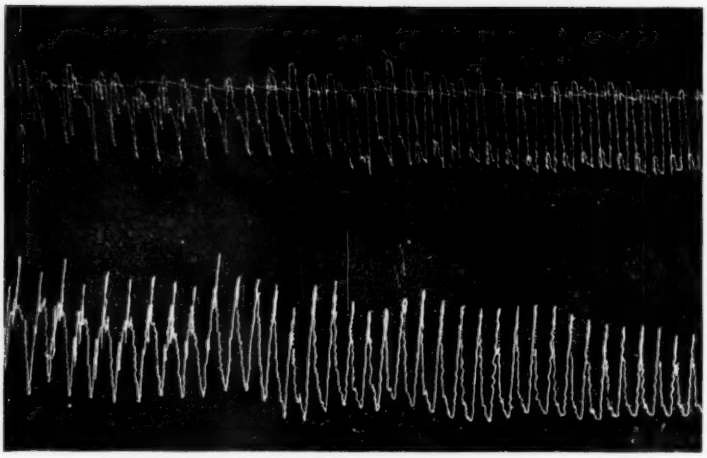


FIG. 2.—Normal dog, (1) under ether, (2) breathing, (3) with abdomen closed. Note continuous contractions.

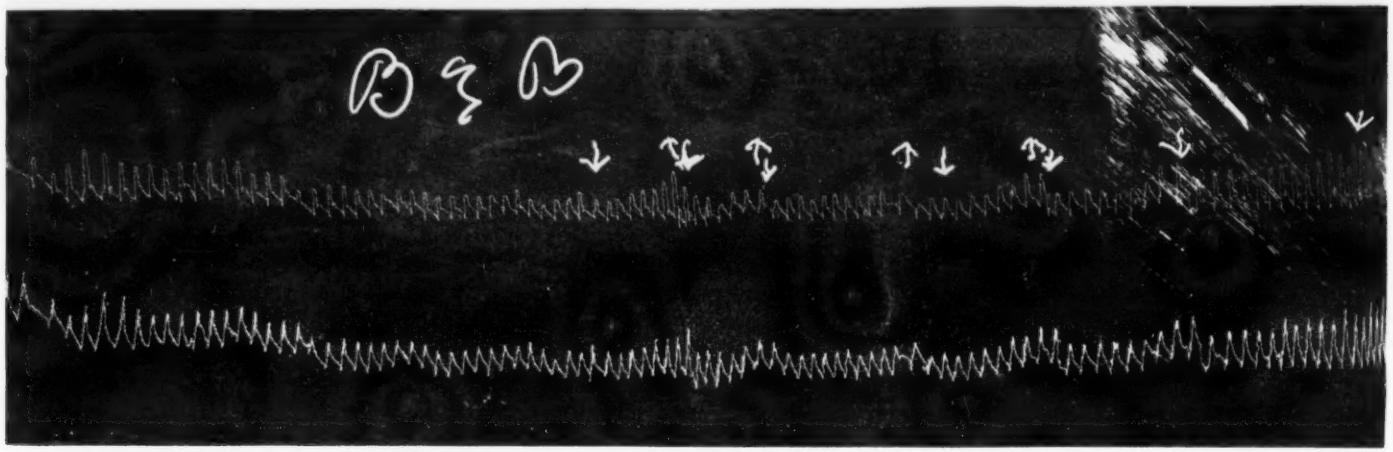
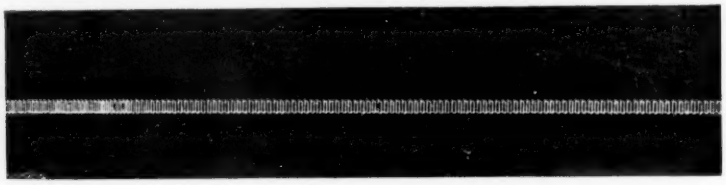


FIG. 3.—February 21, 1916. Normal dog, (1) under ether, (2) breathing, (3) with abdomen opened. Arrows indicate appearance and disappearance of gastric waves. Note continuous contractions. (Tambour above; chloroform manometer below.)

FIG. 4.—February 21, 1916. Normal dog under ether, apnœic, with abdomen opened. Note incontinuous contractions of average ten seconds, with rest intervals of ten to fifty seconds duration, respectively. (Tambour tracing above, chloroform below.)



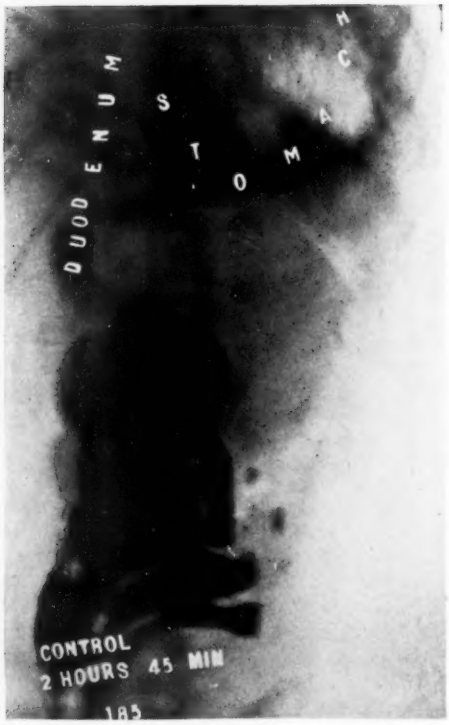


FIG. 5.

152— 2 HRS 51 MIN
TRIANGULAR
GASTRECTOMY

FIG. 6.

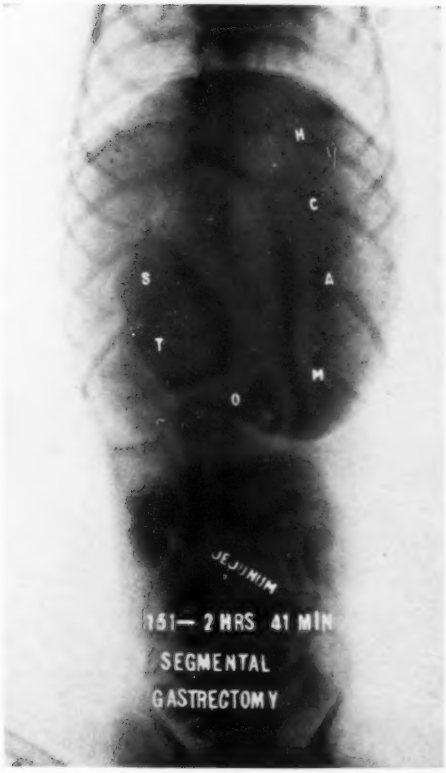

JEJUNUM
151— 2 HRS 41 MIN
SEGMENTAL
GASTRECTOMY

FIG. 7.

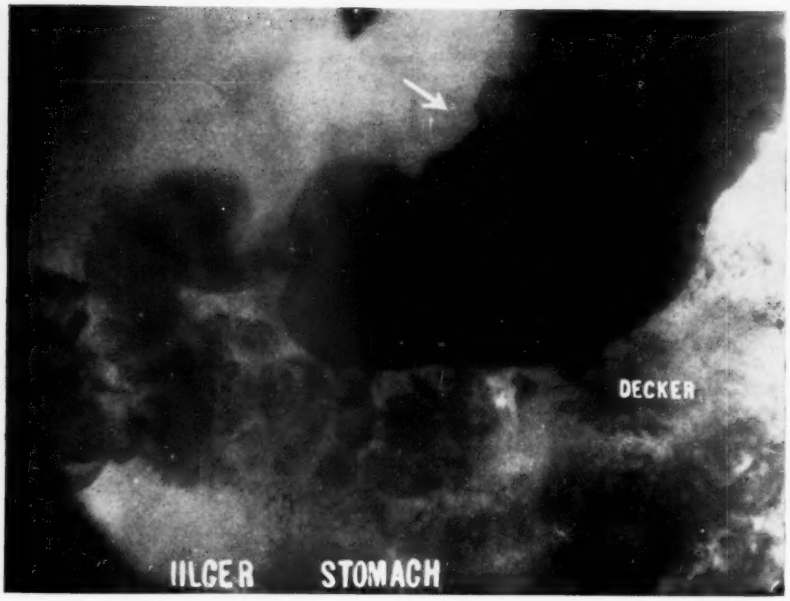


FIG. 8.—Case III.

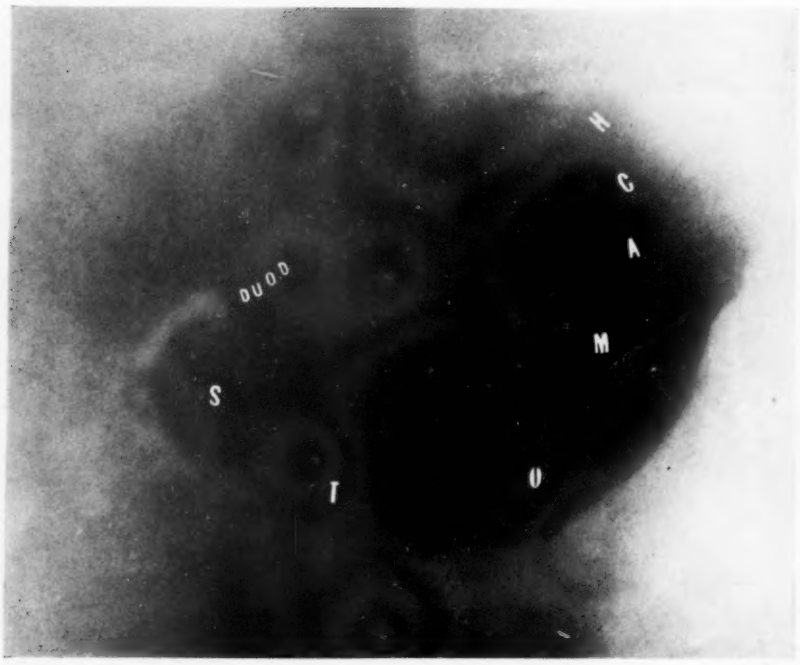


FIG. 9.—Case III.

FIG. 10.—Case IV.

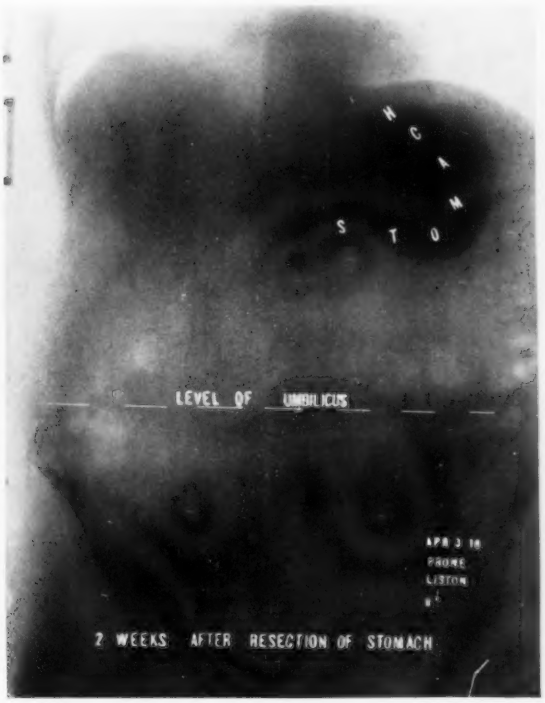


FIG. 11.—Case IV.

3 hours and 20 minutes and the alimentary tract in (less than) 25 hours.

The dog with the triangle removed (152) (Fig. 6) shows a dilated stomach with no duodenal cap and a retention of most of the bismuth in 2 hr. 51 min. The column has reached the colon in 23 hr. 19 min. The segmentally resected animal (151) (Fig. 7) gives a pyloric region less distinctly outlined but a stomach, not as dilated, which empties 50 per cent. in 2 hr. 41 min. The bismuth is in the colon in 23 hr. 15 min. Dog No. 114, in which a segment was removed and the ends were held apart with a fascial transplant, throws a stomach shadow similar to that of the segmentally resected animal (151). All these three pathologic stomachs show on at least one of the exposures a two-cycle stage, similar to, but less distinctly than, the normal stomach (No. 185).

Case I, before operation, shows evidence of ulcer of the lesser curvature and a six-hour residue; after segmental resection, a pyloric end indistinctly filled out and a six-hour retention. Similarly, Case II, before segmental removal, gives indications of ulcer and a six-hour retention, and after, a forcible stomach with an undescribed pyloric end and a six-hour delay. Case III (Figs. 8 and 9) has an ulcer and a six-hour delay before, and a twenty-four hour retention (Doctor Le Wald's Report) after *triangular* gastrectomy. Case IV (Figs. 10 and 11) is well represented in the accompanying photographs. Note that the emptying time only two weeks after the removal of a large-sized segment from the pyloric end and body of the stomach remains the same as before operation, approximately four hours. (X-ray Report.)

This is a preliminary report upon a very interesting subject. The conclusions herein implied are tentative, and require further clinical and experimental study. The purpose has been to determine, if possible, which of the two methods, the resection of the ulcer-bearing segment or the removal of the ulcerous site for gastric ulcer leaves the stomach with the better postoperative motility. W. J. Mayo's report or implication that the " sleeve " resection is followed by good motility is borne out by the present study, certainly, in so far as the proximal segment is concerned, and apparently in respect to the distal one (compare emptying times of the human stomachs, notably Case IV, and of the dogs' stomachs). All the segmentally-resected stomachs have not emptied quite as effectively as normal stomachs but somewhat more satisfactorily than " triangularly " resected ones (Doctor Le Wald's Report on Case III and on Dog 152), as we hope to show more effectively in a subsequent report. This difference in the emptying times may be due in part to the mechanical relations incidental to the gastrectomies (see Table No.

1, Subsequent Report) themselves, but more probably (observations during experimental operations and postoperative tracings) due, in greater part, to the fundamental disturbances in the neuro-muscular motor mechanisms of the stomachs.

The authors desire to thank Prof. Holmes Jackson, of the Department of Physiology, for constructive criticism in the preparation of this article.

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INTRAPARENCHYMATOUS HEMORRHAGE OF THE SPLEEN

HEMORRHAGIC SPLENITIS: INTRASPLENIC HÆMATOMA (NON-TRAUMATIC); APOPLEXY OF THE SPLEEN: FIBRINOUS TRANSFORMATION OF SPLEEN

By Ben D. Baird, M.D.
of Galesburg, Ill.

Two forms of hemorrhage of the spleen are well known in medical literature, viz.: that which accompanies external rupture, and the so-called blood cysts which are believed to be due chiefly to internal hemorrhage of traumatic origin. By some authors the great majority of non-parasitic cysts are placed in the latter category, and no absolute distinction is made between false and true cystic formations, the last named having a true epithelial lining. Profuse hemorrhage may occur within a true cyst.

But aside from these well-known forms there are others which appear to occupy a position midway between them, which are barely alluded to in standard works. It is understood at the outset that hemorrhagic infarctions, vascular tumors, aneurisms and perhaps other conditions are not to be considered in this connection. But few cases are on record, and it is unfortunate that these are very imperfectly described and illustrated. There is an absence of microscopic findings and of blood counts before operation. The case reports refer to intrasplenic hæmatomas, hemorrhagic splenitis, encysted hæmatomas, parenchymatous or diffuse hemorrhage, intracapsular hemorrhage, apoplexy of the spleen, etc. Generally speaking the extravasation of blood is large, often extreme. The whole organ, or one of the two poles, may be involved. The bleeding is apparently of the gravescent type in certain cases, oozing taking place gradually and compressing the splenic tissue. This is well shown in the character of the blood seen in some cases. We may see side by side fresh fluid and clotted blood, layers of unorganized fibrin and organized fibrin. In a so-called primary blood cyst in which escape of blood is limited to a single extravasation in one locality, the blood as a rule is quickly absorbed and the cyst which forms later contains only serum and blood detritus. In rare cases this absorption does not take place, or rather perhaps the lesion is seen at a very early stage before absorption could occur. Whether an encapsulated hæmatoma can become a true cyst seems to be undecided.

Much confusion is due to the fact that some of the interior hemorrhages of the spleen are really subcapsular ruptures. In any rupture of

the organ the blood is apt to accumulate beneath the capsule before rupture of the latter occurs, and the tear in the capsule only allows a part of the pent-up blood to escape into the peritoneal cavity. In a certain number of cases the capsular laceration does not occur until some time after the injury (two-stage rupture), and in a few cases does not occur at all. There is no doubt that some intrasplenic hemorrhages so-called are of this character. The accumulation of blood under the capsule may then compress the spleen and in the end the results will not differ from that produced by a purely intrasplenic hemorrhage. It has been the aim of the author to exclude all such cases from consideration.

Of special literature the chief authority is Camus's thesis on "Traumatic Intrasplenic Hæmatoma," which reproduces a large number of cases from literature. The great majority are cysts of traumatic origin and there are also a number of cases of subcapsular hemorrhage. But few cases are examples of internal hemorrhage in our conception of the term.

Of a considerable number of cases in literature which bear a close resemblance at first sight to the author's case, all have been rejected but four, either because of scantiness of data or because they were clearly subcapsular hemorrhages. Of the five cases not one gave any history of malaria, and the obscure nature of the disease in the five may have had some connection with the nature of the hemorrhage. A brief outline of the cases is appended.

Routier's patient was a woman of twenty-four, in excellent health aside from an obscure enlargement of the spleen of some years' duration. She went through a pregnancy without accident. Eight years after the original enlargement, the organ, hitherto quiescent, underwent further swelling and the size of the spleen then increased until it had to be removed as a mechanical nuisance. The organ weighed 3500 Gm. and its tissue had been partly replaced by fibrin and clots, chiefly at the lower pole. In the entire pulp could be seen fresh foci of hemorrhage and small blood cysts. The case was so unique that the author has no explanation to offer. The secondary enlargement of the spleen was apparently due to a diffuse parenchymatous hemorrhage.

A case of Jordan's was quite similar to the preceding. Jordan speaks of it as a "blood cyst," but R. H. Fowler in commenting on the case terms it a hæmatoma. The patient was a woman of forty-six without history of infection or trauma. The spleen had been enlarged for seven years, and was extirpated for mechanical reasons. It weighed nearly 9 pounds and on section hardly any parenchyma was visible—a connective-tissue wall contained only gelatinous masses of fibrin.

Martyn's case is altogether peculiar. He describes it as one of "acute hemorrhagic splenitis." There was no history of splenic trouble and the patient was

healthy until the third month of her fourth pregnancy, when she became acutely ill with symptoms which suggested acute pancreatitis and peritonitis. Laparotomy showed error in diagnosis. There was some blood in the lesser peritoneal cavity. The woman became worse and aborted. The abdominal wound was tamponed and the uterus curetted. Later the tampon was removed. The patient continued to grow worse until death set in. The spleen was found enlarged, and both subcapsular and parenchymatous hemorrhage was present. There were several large hemorrhages in the parenchyma, and several communications existed between these and a subcapsular clot. The pulp of the spleen was chiefly soft and necrotic. There was some normal pulp. No round-cell infiltration was found. The case is of special interest as showing that foci of internal hemorrhage may be associated with a subcapsular clot. A slight rupture of the capsule at this point had caused bleeding into the lesser peritoneum.

Di Bernardo's case is as follows: Male, aged sixty years, negative history. Sudden pain in splenic area followed by evidences of tumefaction. Two months later examination and puncture led to the diagnosis of hæmatoma. Laparotomy. Removal of two litres of bloody fluid through a small opening. The entire spleen had been disintegrated and altered by accumulation of blood within the capsule.

We are now in position to report our personal case and compare it with the preceding, with a view of learning whether the five cases represent a separate type of affection or are atypical throughout. As will be noted the author's case is very fully reported, with blood counts and microscopic findings.

CASE REPORT.—A. M., thirty-six years old, a native of Illinois; farmer; married, has two healthy children; height, 5 ft. 9 in.; weight, 150 pounds. Referred by Dr. Essex.

Family History.—Father died at age of seventy-three; cause unknown. Mother died of blood poisoning, aged about sixty years. Had one brother who had epithelioma of the lip, which was cured by extirpation. Has two brothers and three sisters, living.

Personal History.—Is without interest until three years ago when he was "threatened with malaria." No treatment was taken and no malaria developed. He was slight of build but never had to consult a physician, excepting for a bad tooth (pyorrhœa), about three years ago (this probably accounts for his threatened malaria), although for six years he had had periodical attacks of headache in right temple, for which no treatment had been sought.

Present Illness.—Patient had complained of feeling tired and weak for about one week; then seventeen days ago, while pulling weeds at 2 P.M., he was seized with a sudden pain in the pit of his stomach. Not a sharp and severe pain, but dull and continuous. He continued his work through the day and all the following day, and until noon of the third day. The pain was continuous and gradually increasing in severity, and on the evening of the third

day it was severe enough to require the administration of morphia, hypodermically. Following this he required from two to six hypodermics daily, and the last few days, hyoscine had been substituted for morphia. With nausea and vomiting the pain gradually worked its way to the left and beneath the edge of his ribs. No hæmatemesis was observed.

Physical Examination.—Skin pallid and moist, face drawn, thin and anæmic; tongue coated; pulse 86 and of fair volume; temperature 98.8; respiration 30 and shallow. Head: Features thin, eyes normal, teeth fair; tonsils, thyroid and pharynx negative. Chest: Dulness and decreased fremitus below the fifth rib on left side. Right side negative. Heart: Sounds normal; apex beat, 1 inch to left and above normal position. Abdomen: Left hypochondrium distended and very tender for 2 inches below edge of ribs. Other abdominal organs normal.

URINALYSIS

Color	Dark amber.
Reaction	Acid (100 per cent.)
Specific gravity	1024
Albumen	½ of 1 per cent.
Sugar	Negative
Indican	Present, large amount
Urea	0.03
Mucin	Present
Bile	Trace
Microscopic	Granular casts, few cells epithelium, leucocytes, crystals, calcium oxalate, bacteria (few).

BLOOD EXAMINATION

Red	3,176,000
Per cent. red cells	62
Hæmo index	.5
Hæmoglobin	40 per cent.
White blood-cells	130,000
Polymorphonuclear	71 per cent.
Large mononuclear	20 per cent.
Small mononuclear	8 per cent.
Eosinophiles	1 per cent.

Red cells, rouletted.
Many normoblasts present.

Diagnosis.—Hemorrhage into spleen, and decision to operate.

Preparation.—Hypodermic of hyoscine, gr. 1/100, morphia sulphate, gr. ¼, one-half hour before operation.

Operation.—Ether anæsthesia. Incision left rectus. Findings: Enlarged, tense spleen, adherent to parietal peritoneum,

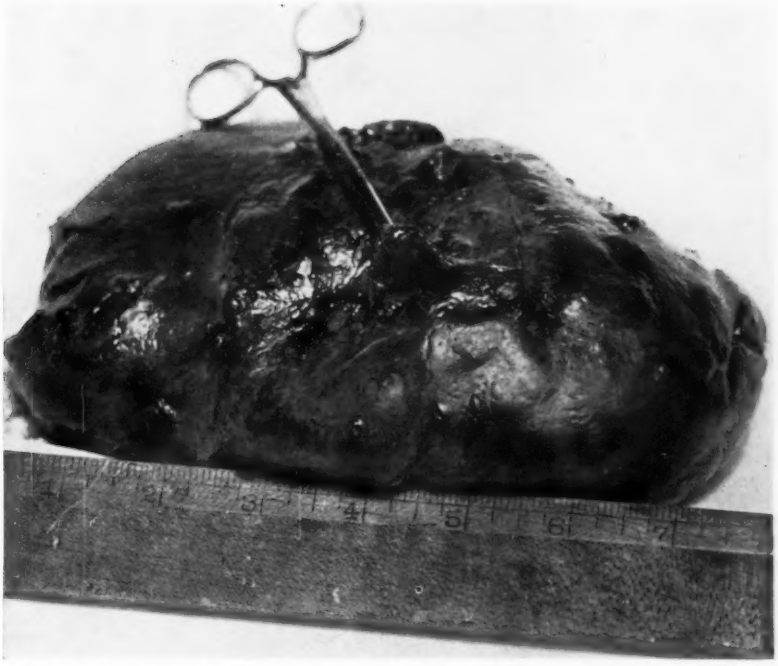

FIG. 1.—Showing condition of spleen after removal; forceps thrust into blood cavity.

FIG. 2.—Removed spleen laid open.

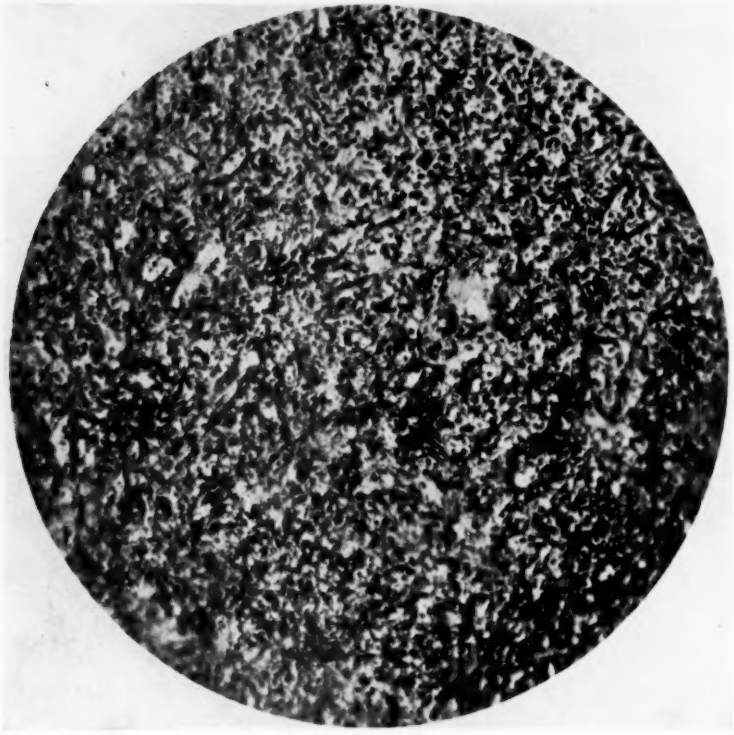

FIG. 3.—Section of spleen, showing round-cell infiltration and increase of connective tissue.

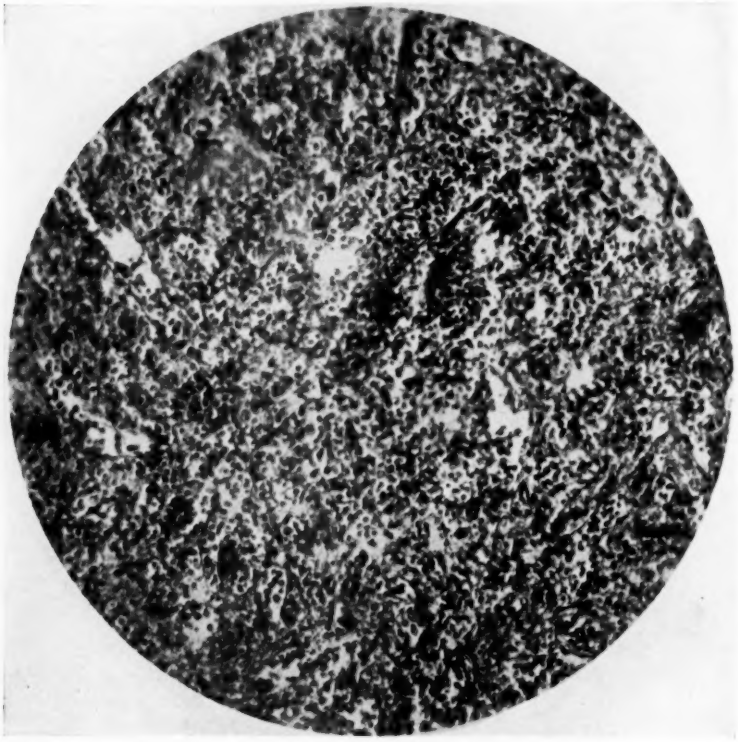

FIG. 4.—Section of spleen, showing round-cell infiltration.

colon, stomach, pancreas and diaphragm. Incision enlarged upward with resection of 2½ inches of eleventh and twelfth ribs for increased space. Spleen accidentally ruptured, allowing approximately 2000 c.c. of blood to escape. The spleen was delivered and pedicle clamped and ligated. The cavity mopped dry and packed with gauze strips. Weight of spleen three hours after removal, 1344 grammes, plus blood (estimated) 3344 grammes.

Unfortunately the hospital records covering the period between the time of operation and his death are not obtainable, but my recollection is that he did not suffer from surgical shock, his temperature did not run high and for three days his condition seemed favorable, but on the fourth day he showed signs of exhaustion, the symptoms becoming more pronounced, until death ensued on the fifth day from general exhaustion, superinduced by the prolonged period of pain and the starvation preceding his operation.

Pathological Findings (as reported by the Columbus Laboratories).—Sections made from spleen show that there is an increase in connective tissue and numerous round-cells (polymorphonuclear). There is no focal necrosis or other change. Our opinion is that this is splenitis simply. Eosinophilia and other special cells are absent.

It is of interest to note the changes in the blood picture for the five days between the time of operation and his death. Particularly the rapid fall in the white count and persistent polymorphonuclear leucocytosis.

Blood examination	First day	Second day	Third day	Fourth day	Fifth day
Hæmoglobin.....	.....	38 per cent.	36 per cent.	35 per cent.	40 per cent.
Red cells per cm....	.....	3,032,000	3,336,000	3,256,000	3,424,000
Red cells.....	.....	60 per cent.	66 per cent.	64 per cent.	68 per cent.
Corps. Hemo index	.....	.5	.4	.4	.4
White cells per cm..	158,000	150,400	118,000	106,400	100,000
Differential					
Polymorphonuclear	.....	60 per cent.	100 per cent.	88 per cent.	92 per cent.
Large mononuclear.	.....	34 per cent.	.....	1 per cent.	4 per cent.
Small mononuclear..	.....	6 per cent.	.....	11 per cent.	4 per cent.
Eosinophiles.....	.....	0	.....	0	0

If we accept the statement of Anders and Boston that in over 80 per cent. of all cases of splenitis the symptoms are indefinite or absent, we can reconcile ourselves to the belief that this was one of the 80 per cent. of symptomless cases in which the disease had insidiously affected the splenic artery until its walls became friable and so weak that the slight effort of pulling weeds ruptured the artery, and we had a rapidly

forming hæmatoma, the blood extravasating through the pulp with its subsequent pressure symptoms and enormous distention of the capsule and perisplenic adhesions.

This would be an easy and perhaps satisfactory explanation of the condition found, if we did not attempt going farther in our efforts to discover why he had splenitis in the first place. Here we confront a stone wall.

A reference to his history shows no past illnesses, excepting pyorrhœa three years before. We then have what appears to be a primary simple splenitis.

ANALYSIS OF FIVE CASES

History of Trauma.—In no case was there a history of any marked traumatism; in the author's case stooping over may have acted as a minimal traumatism.

History of Infection.—None.

History of Pain, Shock, Etc.—In three of the six cases there was pain at the onset—Di Bernardo's, Martyn's and the author's. In the last two it was severe, and led to fatally ending symptoms. Both Martyn and the author regarded their cases as examples of "hemorrhagic splenitis."

History of Prolonged Splenomegaly.—This was absent in the cases of Di Bernardo, Martyn and the author, and present in a high degree in the cases of Routier and Jordan (splenectomy having been done for mechanical reasons only).

Thus far in the analysis the cases of Routier and Jordan compare very well, and there are strong points of resemblance between the cases of Martyn, Di Bernardo and the author (all recently reported).

The cases of Routier and Jordan are examples of a latent hemorrhagic process of a highly diffuse character, in which the organ was almost destroyed. There was no symptomatology. Jordan's case seems to have been furthest advanced, as hardly any parenchyma remained. Enough was present in Routier's case to show that the process was focal in character, the smaller foci probably coalescing in the pole first attacked. Since small foci of hemorrhage may be seen in chronic splenitis, these cases might be termed chronic hemorrhagic splenitis.

There remain for comparison the three related cases of Martyn, Di Bernardo and the author. In none was there any suspicion of any serious trauma (mere stooping over in the author's case), nor any history of infection or splenomegaly. Sudden, severe pain ushered in the condition in spleens doubtless diseased but not known to be so.

After the initial symptoms evidences of an enlarging spleen were noted. In the cases of the author and Martyn the pain was not in the splenic region, but rather in the middle line. Di Bernardo's patient does not appear to have been a sick man, he had no complications. The entire (enlarged) spleen had been almost transformed within two months into a sac of bloody fluid, yet no rupture had been caused. This suggests a slow, gravescent type of bleeding. The author's case resembled the preceding in this respect, for only seventeen days after the onset of the disease, 2000 c.cm. of liquid blood were accidentally evacuated from the spleen. Martyn's case agreed with the author's in the severity of the symptoms and fatal termination. Both Martyn and the author looked upon their cases as examples of splenitis, but Martyn calls his case acute splenitis, a term hardly compatible with the findings. An acute septic abscess of the spleen may be accompanied with hemorrhage, but this case was not of that stamp.

As already stated, there are numerous reported cases which are comparable with the preceding in certain respects.

Two are very old cases incompletely reported. Sangalli describes a case of copious extravasation of blood in a hypertrophied spleen without any history of infection. The splenic tissue was permeated with small areas of capillary hemorrhage. Verga describes an autopsy case of fibrinous transformation of the enlarged spleen. Heurtaux describes a case of an enormous blood cyst in a woman of twenty-seven, following an injury eight years previously. Nine litres of thick altered blood were drawn off. The lesion, however, seemed to be a true cyst, and was readily cured by marsupialization and drainage. Similar cases could be cited. In this connection it must not be forgotten that profuse hemorrhage may occur secondarily in a cyst with serous contents.

A case which was originally thought to possess points of marked resemblance to the author's was that of Solieri. Solieri's case showed notable differences; there is a possibility that it represented a subcapsular rupture. This point is not made sufficiently clear. The patient, aged forty-eight, was an old malarial subject and had just experienced a two-day attack. Upon sneezing he at once experienced pain and shock, suggesting a sudden rupture. The symptoms disappeared but the spleen enlarged steadily for ten weeks. An exploratory incision revealed a spleen tense with blood, which was allowed to escape through a buttonhole opening. The cavity was then closed. The author regards his case as an encysted hæmatoma.

The fact that the splenic tissue aside from the collection of blood was intact and that it was not necessary to extirpate the organ is sufficient to exclude this case from the group cited.

In regard to the real nature of intrasplenic hemorrhages, there are several causes which can account for part of them—as a central laceration, rupture of a diseased blood-vessel, hemorrhage into a pre-existing

cyst. None of these causes, however, can account for diffuse parenchymatous hemorrhage which is most readily explained by the view of a hemorrhagic splenitis, such as is known to occur at times on a relatively small scale. In a large number of sections of extirpated spleens at the Mayo Clinic we find mention of chronic splenitis with small foci of hemorrhage, and there seems to be no reason why this process may not occur on a larger scale. At the same clinic it is admitted that not a few enlarged spleens cannot be classified because of the total absence of any causal factors or associated lesions.

The term splenitis seems to have disappeared largely from the nomenclature. Acute splenitis, if it means anything at all, means a condition terminating in abscess, especially in general sepsis. It is said that septic splenitis of this sort may be hemorrhagic. Aside from this type, diffuse splenitis at its outset is usually termed tumefaction or congestion, and eventually there should be a small cell proliferation. Chronic splenitis has as a synonym fibrosis of the spleen, a condition due to metamorphosis of the new-formed connective tissue.

So great an authority as Baccelli does not apparently recognize simple splenitis as a cause of extravasation of blood. He holds that in a diseased spleen hemorrhage may occur from traumatism, while in non-traumatic cases the efficient cause is a varicose dilatation of the blood-vessels, such as occurs in typhoid and malarial spleens. Other authorities not quoted fail to mention such a condition as hemorrhagic splenitis. In the report of the author's case the pathologist found evidences of simple splenitis, while Martyn's case, termed acute hemorrhagic splenitis, was apparently an acute necrosis. As far as can be made out the spleen in Di Bernardo's case was the seat of a primary degenerative process, while in the remaining cases there is no reference to splenitis or necrosis, but normal splenic tissue was preserved in places. The very extent and long duration of these cases doubtless made it difficult to determine the exact nature of the morbid process involved.

The only conclusion we can reach is that extensive intrasplenic extravasations are very rare and not associated with any one special morbid process. No doubt in the past they have been regarded as false blood cysts, although the latter have almost invariably been reckoned as of traumatic origin, and in the vast majority of cases they have occurred in infected spleens. These two factors have been practically absent in the material we have analyzed. The slow and progressive as well as the diffuse character of the process is in evidence in several of the cases not only clinically, but pathologically.

The author has studied a number of recently reported cases of external rupture of the spleen in the hope of finding some basic resemblance to the cases detailed in the paper. In the traumatic cases violence was always marked and often extreme, while spontaneous ruptures practically always occurred in the presence of severe infections.

In conclusion the author acknowledges the assistance of Dr. Edward Preble, of New York City, in collecting the references and arranging the material for the paper.

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CHOLEDOCHUS CYST

REPORT OF A CASE WITH REFERENCES TO THE LITERATURE

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Idiopathic choledochus cyst is an extremely rare anomaly of the common bile-duct. Langenbuch, up to 1897, was able to find but a single case, that of Konitzky. Lavenson, in 1909, collected 28 cases of cysts of the common bile-duct. These included cases other than those of the idiopathic variety. Schloessman, in 1911, collected 16 cases which he considered represented all the cases of idiopathic choledochus cyst in the literature up to that time. Kehr, in 1915, after a careful study of the literature, places the number of idiopathic choledochus cysts at 19. including Konitzky's case. Kehr, himself, in his extensive experience had not observed a single case.

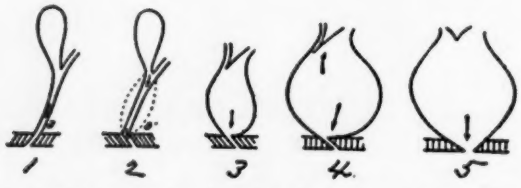

Fig. 1.—Rostowzew's explanation of the formation of choledochus cyst.

Idiopathic choledochus cyst is not to be confused with enlargement of the choledochus due to stone or tumor. Langenbuch, who was the first to direct attention to this condition of idiopathic choledochus cyst, was familiar with cases in which the common duct was enormously enlarged from obstruction, and differentiated Konitzky's case therefrom.

The cases of so-called idiopathic choledochus cyst are congenital anomalies. The enlargement is most marked in the middle and upper portion of the common duct. Rostowzew gives a plausible explanation of their occurrence. This is shown in the accompanying line drawings. In Fig. 1 is shown the normal course of the common bile-duct following a practically straight course through the duodenal wall; in Fig. 1, 2, the course of the duct in its passage through the wall of the duodenum is changed so that the duodenal portion is at an angle with the portion of the duct extraduodenal. The interference with the *direct* flow of bile

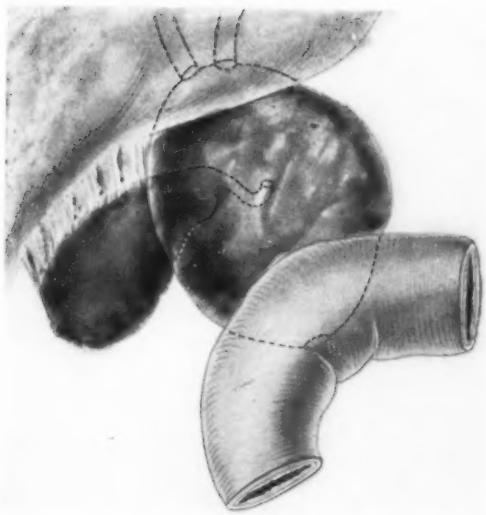

FIG. 2.—Choledochus cyst.

into the duodenum results, according to Rostowzew, in an enlargement of the common duct, as shown in Fig. 1, 3, 4 and 5. This explanation, while plausible, does not meet all the requirements of the anomalous condition. To the writer's mind the condition is one of congenital malformation. This view coincides with all the anatomical data at hand.

G. H., No. 33,366. A. C., male, aged twenty-two. Admitted December 2, 1915.

Operation, December 7, 1915, cholecystectomy, choledochotomy.

Chief Complaint.—Pain in epigastrium extending along the lower border of the ribs on the right side to the back; nausea but no vomiting.

Present Illness.—Began November 25, after breakfast, when patient complained of severe cramps in the epigastrium; cold sweat, nausea. A physician was called and gave a hypodermic injection which relieved the pain. The following day there was a similar attack, but more severe; the area of pain at this attack was at the tip of the tenth rib and radiated to the back just to the right of the vertebral column. It felt as if a knife was sticking in his back. When he took medicine (sedative?) the pain subsided. The next day he had a similar attack but less severe and accompanied by soreness in the back. From this time to the time of operation there were many slight attacks of pain in the epigastrium, stabbing in character and radiating to the back. There was loss of appetite and constipation. People told him he looked yellow during these attacks, and the stools were clay colored.

Examination.—The abdomen was somewhat rigid and distended; there was tenderness over the gall-bladder region and slight tenderness to the right of the vertebral column, just below the rib border; slight fever.

Diagnosis.—Cholecystitis acute. Cholangeitis.

Operation (December 7, 1915).—High right rectus incision; there was no large intestine on the right side of the abdomen. The large intestine was down in the pelvis. The mesentery of the large intestine seemed to originate below the mesentery of the small intestine. The gall-bladder was enlarged and slightly thickened; no external evidence of acute inflammation. No gall-stones found; the cystic duct was enlarged and tortuous. The common duct was dilated to the size of a large orange and had the appearance of a cyst (Fig. 2). Evidence of chronic pancreatitis was present (areas of old fat necrosis). The appendix was removed in the usual manner. The gall-bladder was removed. So enormous was

the dilatation of the common duct that the possibility of an echinococcus cyst was thought of. A hypodermic needle was introduced into the duct and clear bile withdrawn. The duct was then opened. Its walls were very thin. There was an immediate escape of clear bile. The opening in the duct was enlarged sufficiently to admit the finger. Digital examination disclosed a smooth-walled cavity with four openings; two above, which were undoubtedly the hepatic duct openings; one laterally, the cystic duct opening; one below, the opening of the common duct into the duodenum. This latter was large enough to admit the tip of the examining finger into the duodenum; the other openings were somewhat smaller. All the openings were firmly resistant to further dilatation. The common duct was drained by a small rubber tube fastened with a purse-string of plain catgut. A split tube drain was placed in the foramen of Winslow.

Pathological Examination.—Macroscopic: the gall-bladder was somewhat enlarged, the walls thickened, the cystic duct enlarged, thickened and tortuous and entered the gall-bladder at a more acute angle than usual. The mucous membrane was thickened, the epithelium lacking in places. Microscopic diagnosis, *cholecystitis chronica.* Culture from the common duct negative.

After Course.—There was very little fever; three days after operation the temperature was normal. Pulse went up to 130 after operation and gradually came down to normal on the fourth day; after that it varied between normal and 100. Respiration remained normal throughout. Patient had slight pain, vomited once or twice during the first few days after operation. There was quite a little bloody discharge for two or three days from the split tube drain and wound. A week after operation pulse, temperature and respiration were practically normal; pulse of fair quality. There was bile drainage through the tube; no complaint of pain. A blood clot formed in the wound and became infected. After cleansing the wound was united by secondary suture. The second week patient began to complain of slight pain in the wound region and there was increased drainage of bile through the tube. Practically all the bile escaped externally. This was strained and injected by rectal tube in the colon, where it was moderately well tolerated. The stools were clay colored throughout. From this time on the patient began to lose strength slowly. On the twelfth day a perirectal abscess was incised. There was occasional vomiting. Cardiac stimulation became necessary. In spite of all efforts the patient gradually lost weight and strength; his pulse became very weak and gradually imperceptible until De-

cember 29, 1915, when he died of asthenia. For twelve hours before death there was no escape of bile from the wound.

Autopsy was refused.

Remarks.—This condition is so rare that it perhaps is idle to discuss the possibility of cure. Most of these cases die in childhood from cholangeitis; the dilated duodenal opening predisposing to early infection. Should another case present, however, I would resect as much of the common duct as possible in an attempt to reduce the duct to approximately normal size; although owing to the anatomical anomaly present at the opening of the duct into the duodenal, it is quite improbable that such an attempt would be successful.

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RETROPERITONEAL RUPTURE OF THE DUODENUM BY BLUNT FORCE

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Rupture of the gastro-intestinal tract produced by the action of blunt force with little or no injury of the abdominal wall is one of the most interesting subjects in the whole field of traumatic surgery. We have now systematic knowledge of this whole group of cases and it is very generally agreed that such injuries are produced almost always by one of three methods, namely, crushing of the bowel between the force which is acting and the spine, bursting by increasing internal pressure within a loop whose ends are momentarily closed, and, finally, tearing of the bowel at a point of juncture between a fixed and a relatively free sector of the gut. There are, of course, other unusual methods of production which are matters largely of academic interest. Bowlby (*British Journal of Surgery,* 1916, vol. iii, No. 11, p. 463) has recently described what appeared to be a rupture of the bowel due to the air pressure exerted by a high velocity bullet traversing the abdominal wall and not entering the peritoneal cavity.

In the study of the general subject of subcutaneous rupture of the bowel, comparatively little attention has been paid to the peculiar features of rupture of the duodenum, although this lesion forms apparently about 10 per cent. of the total material. This seems a surprisingly high percentage, and yet of the 132 cases reported by Berry and Guiseppi (*Proc. Royal. Soc. Medicine,* 1909, vol. ii, Surg. Section, 1–66), a series which includes all cases occurring in ten London hospitals between 1893 and 1907, 18 per cent. of the total number are ruptures of the duodenum. Still less attention has been paid to the quite characteristic features presented by retroperitoneal rupture of the duodenum, although from 25 per cent. (Berry and Guiseppi) to 33 per cent. (Schumacher, *Beitrage zur Klinischen Chirurgie,* 1910, Bd. 71, p. 482) of all traumatic duodenal ruptures due to blunt force are retroperitoneal and do not communicate with the peritoneal cavity as a primary effect of the original injury. This particular lesion apparently has a mortality of about 90 per cent. as contrasted with the estimated mortality of subcutaneous bowel rupture in general of 70 per cent.; although mortality figures in this general group of cases are of

doubtful value, since mortality varies rather directly with the length of time intervening between injury and operative interference, nevertheless, a comparison of the various statistical tables presented in the literature shows a consistently higher mortality for subcutaneous retroperitoneal rupture of the duodenum than for blunt force rupture of the gastro-intestinal tract in general. The rather sparse literature dealing with the topic under discussion evidences our failure to appreciate the frequency of this lesion and its extremely fatal effect. One ex-

FIG. 1.—Double traumatic retroperitoneal rupture of the second portion of the duodenum. The pyloric portion of the stomach and the duodenum have been opened, showing the appearance of the ruptures on the mucosal surface. The sizes of the ruptures are somewhat exaggerated in the drawing. Note the proximity to the papilla of Vater.

planation of the high mortality rate is the obscurity of the lesion. With intraperitoneal rupture of the bowel, it is seldom difficult to find the lesion promptly after the abdomen has been opened. This is not true, however, of retroperitoneal rupture of the duodenum; in a series of 37 reported operations, the lesion was missed 13 times, or in approximately one-third of the cases, although the laparotomies were made by competent surgeons and with the probable diagnosis in mind. In contrast

to this is the fact that subcutaneous retroperitoneal duodenal rupture produces a striking and constant pathological change which is easily found and just as easily interpreted during the course of the operation. The operative findings are practically pathognomonic. In view of the above facts, it seems worth while to report a personal case and to present the result of the study of the literature. The following report is based upon a series of 22 cases, occurring since 1910, the date of the appearance of an article by Schumacher, who reviewed very thoroughly the subject up to that time, reporting a series of 24 cases; there are thus available practically 50 cases, from whose study definite knowledge is to be gained.

CASE REPORT.—Retroperitoneal rupture of the duodenum by blunt force. Operation on the tenth day. Death within fifty hours after operation. Autopsy.

J. L., male, aged twenty-one, miner, admitted October 26, 1915. Hospital No. 2567. Previous history unimportant.

Present Illness.—Three days ago the patient was kicked by a mule, whose hoof struck him in the right upper quadrant of the abdomen and in the right flank. The blow did not knock him down, though a little later he fell to the ground; he was picked up and taken home. During the remainder of the day the patient had no severe pain and sat up in a chair at intervals. After an unstated period he began to complain of pain over the entire abdomen, definitely cramp-like in character. He has taken small amounts of water since the accident, but with the onset of pain became nauseated and has vomited several times. The patient has voided normally and there is no history of blood in the urine. Last night the patient was unable to sleep soundly because of abdominal pain, and he was brought to the hospital this morning, since his condition did not seem to be improving. His friends volunteer the information that the mule was a rather decrepid animal and, they seem to think, quite unable to kick hard enough to cause much damage; in this and other ways, they minimize the severity of the accident, insisting that the patient's discomfort has been, even up to the present time, so slight as to be of no great moment. They seek aid because "he did not seem to be doing well," rather than because of pain.

Examination.—Patient is a well-nourished man, apparently not in great pain. Facial expression is not that of an acutely ill person. Pulse 80 to the minute, regular and full. Temperature per rectum 101°. Respirations regular, 32 to the minute. Leucocytes 5100. Chest negative.

Abdomen: No external evidence of injury. Moderate general symmetrical distention. Abdominal respiratory movements decreased, especially on the right side, where deep inspiration causes much pain. No masses or visible peristalsis. On palpation, slight general tenderness and very slight muscle spasm, more marked on right side than on left and maximum in the right upper quadrant. Definite tenderness in the right flank and quite acute tenderness below the right twelfth rib in the back. On percussion, impairment of the note in the right lower quadrant extending into the right flank. Liver dulness present. Rectal examination negative. No evidence of bony deformity.

Impression: The patient does not seem ill and is not in great pain. The abdominal examination is quite comparable to that seen in simple abdominal contusion. The pulse is normal and the leucocytes are even subnormal. The patient was put to bed for observation.

Nine hours subsequently there was no change in the patient's condition other than the fact that the temperature by rectum reached 102.6°. Bowels moved well after an enema. The lesion was not considered a progressive one and accordingly the patient was treated expectantly.

October 27, 1915: Condition apparently much improved. There is very slight distention and there is no tenderness except in the right upper quadrant and in the back, where it is very much less than yesterday. Temperature 100°; pulse 84. The patient volunteers the information that he feels much better.

November 3, 1915: During the past seven days the temperature has shown a gradual fall, being usually about 99° or less, though reaching 101° on October 29, four days ago. The leucocytes have never been above 8000 on daily counts. He has been taking liquid nourishment in limited amounts and until this morning seemed to be improving. Last night the patient vomited and again this morning. There is definite visible peristalsis from left to right in the upper abdomen. The expression is not so good. Operation advised, in the presence of a normal leucocyte count, normal pulse-rate and a practically normal temperature.

Operation (November 3, 1915).—Exploratory laparotomy. Findings: retroperitoneal perforation in the second portion of the duodenum with localized retroperitoneal abscess. Patient stood operation poorly, hence impossible to attempt closure by suture. Drainage.

With the patient in surgical anæsthesia, there became evident for the first time a fixed mass occupying the greater portion of the right upper quadrant. High right rectus incision. The peritoneal cav-

ity was quite clean throughout and contained little or no free fluid. In the right upper quadrant, there were extensive recent adhesions between the liver and the adjoining viscera. After the general peritoneal cavity had been packed off, these adhesions were broken

FIG. 2.—The specimen as seen from the posterior aspect. The retroperitoneal portion of the duodenum is deeply shaded and the ruptures are seen to be entirely in this area.

up. The liver was found uninjured. Proceeding further, there was opened a retroperitoneal abscess lying behind the first and second portions of the duodenum and apparently well localized; from this abscess there was evacuated about 6 ounces of bile-

stained, foul-smelling pus. Further investigation disclosed a perforation on the posterior aspect of the superior half of the second portion of the duodenum. The perforation just admitted the finger tip. With the limited mobilization of the duodenum allowed by the adhesions, the perforation was quite inaccessible to suture. Gastro-enterostomy, though diverting the gastric contents from the injured area, would in no way prevent the escape of pancreatic secretion and bile and was therefore not indicated. The patient's condition became quite urgent and for this reason we were forced to content ourselves with free drainage only. The prognosis seemed exceedingly bad.

November 5, 1915: The patient died about fifty hours after operation, having during this time failed to improve in any way. There was a very free discharge from the wound.

Autopsy.—There was a general plastic exudate throughout the peritoneal cavity. In the pelvis there was a small amount of yellowish purulent exudate. The appendix was negative. The duodenum showed two perforations; the first, measuring 1.5 cm. in diameter, was situated on the retroperitoneal aspect of the second portion of the duodenum, 2 cm. above the papilla of Vater, and the second perforation, 1 cm. in diameter, was also in a retroperitoneal position, 1 cm. above the papilla of Vater. The perforations had clean edges with pouting margins and showed no evidence of sloughing. The adjacent intestinal wall was healthy. The papilla of Vater was uninjured. All the retroperitoneal tissues of the right flank from the duodenum downward to the brim of the pelvis were of a dark red color, soft, spongy and bathed in brownish pus. About the right kidney, this retroperitoneal cellulitis was particularly marked. The remaining facts discovered at autopsy were of no particular significance other than as showing a moderate degree of general systemic reaction to infection.

In considering this case, one is struck by the contrast between the relatively slight accident and deceptive condition of the patient and the fatal type of injury produced. At autopsy, the appearance of the ruptures made it quite evident that they had been produced at the time of the accident and were not the result of secondary necrosis in the bruised duodenal wall; the patient had been developing a large retroperitoneal abscess during the period of ten days intervening between injury and operation, though during this time his leucocytes were not above normal, his pulse-rate was not above normal and his temperature showed only moderate variation from the normal. The abdominal signs during this period were correspondingly negative and the patient's statement of his own condition was always to the effect that he " felt better." Operation was finally made on the tenth day after injury because the patient vomited twice in rather large amounts, second, be-

cause a short time before operation, he showed marked visible peristalsis in the upper abdomen from the left to the right and certainly in the stomach wall, and, finally, because of the sudden and rapid change of facial expression. The slight general and local reaction during the formation of the retroperitoneal abscess may possibly be explained in part by the relative sterility of extravasated duodenal contents. One of the chief indications for interference we had was definite evidence of obstruction in the region of the pylorus; operation disclosed the second portion of the duodenum compressed to the point of complete occlusion between a massive abscess behind and the tensely stretched peritoneum in front. This sign, though diagnostic in our case, is of little practical importance, since it can develop only late and, hence, at a time when any treatment would be probably without avail. In general, the case varied only slightly from the picture so frequently seen in abdominal contusion without intraperitoneal injury, and in reviewing the case, the author has the feeling that this patient could have been rescued only by following a rule of invariable operation on the slightest suspicion of intra-abdominal injury. This, of course, is one lesson to be learned from the study of subcutaneous rupture of the bowel in general, but it is only by the exercise of the keenest diagnostic discrimination that one can possibly avoid exploring many negative cases. One other point of interest is the presence of tenderness beneath the right twelfth rib. This was present in only one other case of my series, which seems curious, since with right-sided subphrenic abscess this sign is fairly constant. Careful observation with reference to this point should help in diagnosis.

In 1910, Schumacher reported a case of retroperitoneal rupture of the duodenum and presented a review of the subject up to that time, incorporating the work of Jeannel (*Archives Prov.*, 1899, Nos. 7, 8 and 9) and Meerwein (*Beitrage zur Klinischen Chirurgie*, 1907, Bd. 53, p. 496) in his report. He collected 91 cases of rupture of the duodenum by blunt force, in 24 of which the rupture was retroperitoneal. In the literature since his time, there are found 22 typical cases of retroperitoneal rupture of the duodenum. I have made no attempt to collect all cases of rupture of the duodenum, but have selected only those in which the primary force produced a rupture of the duodenum, which communicated in no demonstrable way with the peritoneal cavity. One case was found in which there was an associated primary tear of the overlying peritoneum without a resultant peritonitis (Group II) and two cases of partial retroperitoneal rupture were encountered (Group IV). Three additional cases were found, in 2 of which a

second simultaneous rupture of the duodenum communicated with the peritoneal cavity and, in the third, one rupture involved both the retro- and intraperitoneal surfaces of the duodenum.

The study herewith presented is based thus on 28 cases, but the major part dealing with the characteristic clinical and pathological features of retroperitoneal rupture is based on the 22 typical cases in my series and Schumacher's 24 cases.

This injury is almost peculiar to the male during his active working years. Twenty-four of the cases were in men, the average age being about twenty-four years, 13 of the cases occurring before or during the twentieth year.

The accident sustained does not differ materially from that found in subcutaneous ruptures in general. Of the 22 cases, 7 were crushed between a heavy fixed and a heavy moving object, usually a wall and a wagon, 7 were struck on the abdomen by a blunt object, such as a rake handle, a board, a heavy piece of iron, etc., 6 were run over, 6 were kicked, notable in this group being 2 in which the injury was caused during a foot-ball game by the patient receiving a kick from a "player's knee"; in one instance, the lesion was produced by a fall on a fixed object and in another by a horse falling on the patient. The etiology seems to vary markedly with different series; for instance, in Berry and Guiseppi's 132 cases of subcutaneous rupture of the bowel there were 51 cases in which the injury was caused by the patient being run over. Although the kick of a horse figures heavily in most of the reported groups, nevertheless, the military surgeons tell us that only a few such accidents result in rupture of the bowel; Pech (quoted from Berry and Guiseppi) states that of 71 cases of abdominal injuries from horse kicks and occurring at one of the foreign barracks in twenty years, 69 recovered without operation and 2 died from rupture of the bowel. Rupture of the duodenum is especially frequent in blows received in the upper abdomen or directed toward the upper, though received in the lower abdomen.

Situation and Character of the Rupture.—Of the 22 cases studied, in 18, or 82 per cent., the rupture was situated in the second or third part of the duodenum. In Schumacher's 22 cases, all of the ruptures were situated in the second or third portions of the duodenum. The lesion produced is usually "punctate" in character (8 cases), though a large number of them are circumferential (6 cases) and only the odd case has a rupture parallel to the long axis of the bowel (1 case). The punctate lesion varies in size up to 4½ cm. in diameter and usually has clean-cut edges with everted mucosa. Necrosis of the adjacent bowel

wall is uncommon, from which one can reasonably infer that these punctate lesions are produced at the time of the accident and are not the result of secondary sloughing. Of the 6 circumferential tears, but 2 caused complete division (in parts 3 and 4); this type of tear usually extends one-half or two-thirds of the way around the bowel, leaving a strip of undivided bowel wall. There occurred 2 cases in which the duodenum showed two discrete retroperitoneal ruptures (Cope, *Proc. Royal Soc. Med.*, London, 1913–1914, vol. vii, Surg. Section, 86–107, and the author's case); both cases involved only the second portion of the duodenum. In Group III, there was found 1 case in which there had occurred two simultaneous punctate ruptures, one on the posterior wall and one on the anterior wall, the lesions being directly opposite each other (Quenu and Matthieu, *Bull. et mem. Soc. de Chir. de Paris,* 1912, n.s. xxxviii, p. 234). It is interesting to note that in Schumacher's 22 cases, there occurred but 2 cases of double rupture.

Operative Findings.—Of the 22 cases, 16 are described more or less accurately with reference to operative findings. Thirteen of these showed at operation either a retroperitoneal hæmatoma or a retroperitoneal extravasation, and of the remaining 3 cases at least 2, from the description given, must have had similar findings. This hemorrhage, or extravasation, or a combination of the two occupies a perfectly characteristic position, namely, it is always found either in the root of the transverse mesocolon, in the root of the mesentery of the small bowel, or involving both of these structures and the intervening retroperitoneal space, very frequently extending somewhat to the right over the kidney. The tumor is usually crepitant, since it contains gas and appears quite dark when the blood is in excess or of a rather light grayish color, shimmering through the overlying peritoneum, when extravasation and suppuration dominate. The extravasation after the receipt of the injury is usually rapid; in 1 case (Helfrich, reference from Schumacher), the operator observed the actual spread of the escaping gas in the mesocolon and thus into the wall of the ascending colon, a fact which led him to a diagnosis of traumatic perforation of the bowel. The content of this swelling when incised shortly after the receipt of injury is variously bloody, bile-stained, or darkish colored fluid, mixed with gas; it soon becomes purulent and of foul odor, while in a few cases the adjoining tissues are black and gangrenous, this latter finding probably owing to associated injury to the pancreas. When exposed within a reasonably brief time after the receipt of injury, the extravasation or hemorrhage is usually limited to the outlines mentioned above; as time elapses, it spreads rapidly. The peritoneal cavity commonly

contains a certain amount of free fluid, usually described as blood-stained and in a few instances as bile-stained. The source of this blood is usually not discovered; inasmuch as the posterior peritoneum is intact, it probably comes from an associated minor rupture of liver or some adjacent viscus. In perfectly characteristic cases, there are found multiple petechial subperitoneal hemorrhages scattered over the transverse mesocolon, the ascending and transverse colon, the omentum and the mesentery. Winiwarter (*Deutsche Zeitschrift fur Chirurgie,* 1912, vol. cxiii, p. 582) has drawn attention to this appearance and described it as typical. Fat necrosis was observed in but 3 cases, scattered over the hepatic flexure, the transverse colon, the transverse mesocolon and the omentum. In but one of these cases was the pancreas possibly involved grossly in the original injury. The intimate anatomical association between the duodenum and the pancreas would lead one to suppose that violent injury of the duodenum would be rather constantly associated with primary gross lesion of the pancreas, but autopsy records do not bear this out. Two cases showed marked dilatation of the stomach and transverse colon (Nos. 13 and 22); 2 cases showed laceration of the mesentery at time of operation (Nos. 11 and 18). When operation is made within a reasonably short time after injury, say within the first forty-eight hours, the above findings are constant and the peritoneal cavity itself is clean. It is true that there is commonly found a little fluid in the peritoneal cavity, and perhaps in a strict bacteriological sense, one would not be justified in regarding the peritoneum as sterile, nevertheless, there is practically never found, at reasonably early operation, a peritoneal cavity which is acutely inflamed in the sense that there is evident serofibrinous exudate. This fact is very striking and is of great importance.

Given a case of blunt force violence in the upper abdomen, resulting in symptoms which lead one to explore the peritoneal cavity, the typical findings, with retroperitoneal rupture of the duodenum, are a clean peritoneal cavity with a little free blood-stained fluid, a hemorrhagic crepitant swelling in the root of the transverse mesocolon extending over the right kidney and down into the root of the mesentery, petechial subperitoneal hemorrhages and possibly fat necrosis in the transverse mesocolon, the ascending and transverse colon and the mesentery. These findings are, in the main, constant in the 16 accurately described cases of the 22 studied. It is virtually pathognomonic to find such a swelling behind a clean peritoneal cavity. Surely so typical a picture should lead one to immediate diagnosis, and yet of the 21 cases operated upon, the rupture was missed 8 times, although laparotomy was under-

taken because of probable rupture of the bowel. It seems certain that had the surgeons been familiar with the very definite operative findings, none of these 8 cases would have been closed without the rupture being found. In Schumacher's group of 16 cases submitted to operation, the rupture was missed 6 times, although diligently searched for. The

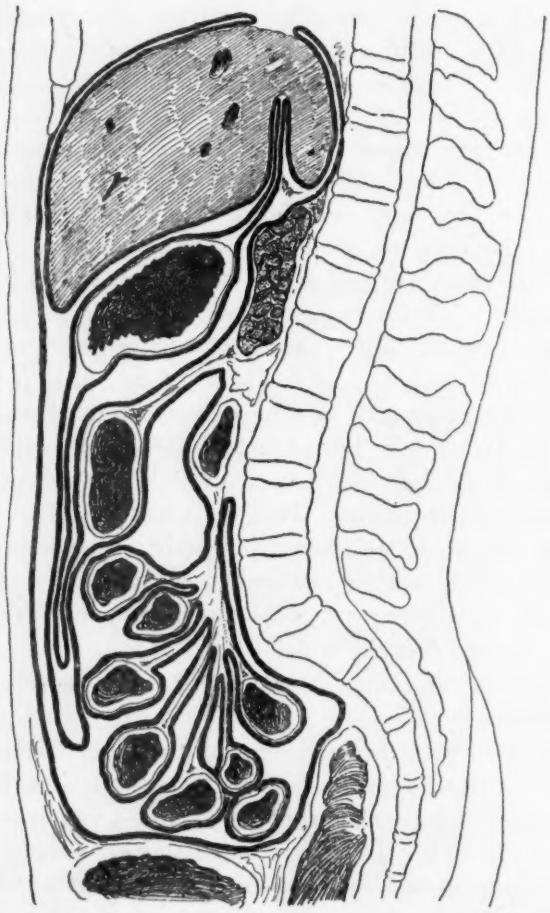

FIG. 3.—Schematic sagittal section of the abdominal cavity in the midline, showing the cross-section of the third portion of the duodenum and the relationship to the root of the transverse mesocolon and the root of the mesentery. (Adapted from Spalteholz.)

large proportion of cases in which the rupture was missed at operation is particularly striking, when one remembers that the cases were in the hands of thoroughly trained abdominal surgeons.

Spread of Extravasation.—The occurrence of retroperitoneal extravasation is constant, there being but one exception that I have encoun-

tered, namely, the case of Thompson (Schumacher's reference), in which the rupture was plugged by clotted blood. Figs. 3 and 4 give a very good idea of the relations existing between the second part of the duodenum and the root of the transverse mesocolon as against those between the third part of the duodenum and the root of the mesentery; this relationship would lead one to expect rupture of the second part to result in extravasation primarily into the transverse mesocolon, and rupture of the third part into the root of the mesentery. Such a relationship, however, has not been described in the recorded cases. The extravasation makes its appearance in the region of the root of the transverse mesocolon, spreading from this point out over the right kidney and downward into the root of the mesentery; in its further

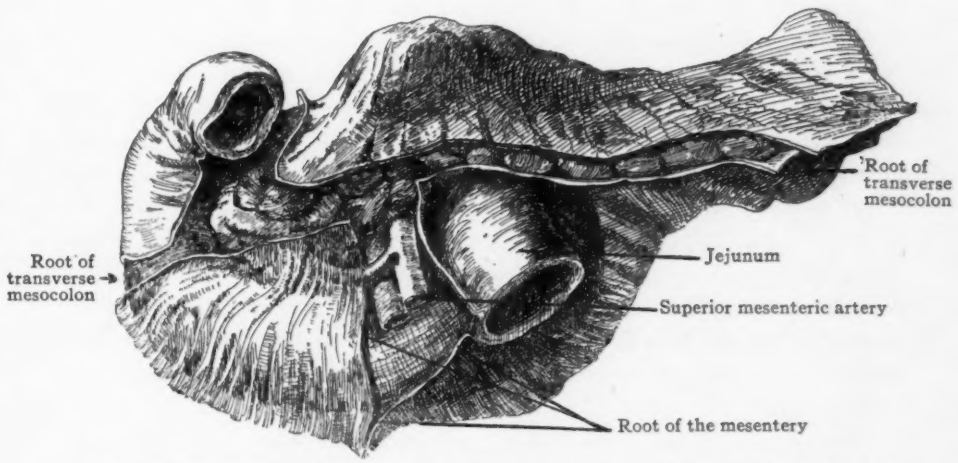

FIG. 4.—Duodenum and pancreas, viewed from in front. A piece of the first portion of the duodenum has been cut off. The peritoneum has been cut away exactly at the point where it turns away from the duodenum and pancreas. (Adapted from Spalteholz.)

progress it follows down behind the ascending colon even extending perhaps into the pelvis. In extreme cases, it may cross to the left side, involving virtually the entire retroperitoneal space. Rarely, the extravasation may point in the region of Poupart's ligament (Petren, ANNALS OF SURGERY, 1915, vol. lxi, p. 414). While the extent of the extravasation as outlined above is almost constant, it is not invariably present; Maddock (*British Medical Journal*, 1914, p. 852) reports a case in which the suppurative process travelled laterally along the ribs, producing an abscess in the right lobe of the liver and pointing low in the axilla. Keller (*Beitrage zur Klinischen Chirurgie*, 1914, vol. xc, p. 451) reports a case in which there was, in addition to widespread retro-

peritoneal extravasation, purulent mediastinitis and pleurisy. Retroperitoneal extravasation from a duodenal leak may travel upward along the great vessels and thus gain access to the mediastinum; however, progress by this route is rare and usually associated with a slow leak of the duodenum, such as occurs in subacute perforating ulcers of the posterior wall. Petren has made a very interesting report on this subject.

Peritonitis.—There has been more or less discussion as to how much protection against the rapid onset of peritonitis is given a patient by the fact that the rupture is entirely retroperitoneal and does not leak into the peritoneal cavity. The opinion has even been expressed that peritonitis follows just as certainly and just as quickly after retroperitoneal rupture of the duodenum as after intraperitoneal rupture; a study of the reported cases does not bear this out. Peritonitis, undoubtedly, will follow in most cases unless operation is made promptly; there is, however, a very definite delay in its appearance due to the protection afforded by the intact posterior peritoneum. Any type of retroperitoneal suppuration, if neglected, may and probably will result in peritonitis. This question, however, is largely a matter of academic interest, since there can hardly be a great difference between the mortality of widespread retroperitoneal suppuration and that of generalized peritonitis, the one being quite as fatal as the other. The essential thing is to recognize the presence of a leak in the gastro-intestinal tract promptly; unless this is done, retroperitoneal suppuration inevitably follows and later a general peritonitis as well, either of which is usually fatal.

The extravasation early in a typical case may occur so rapidly and yet be so well localized as to produce a fixed tumor in the right upper quadrant of the abdomen. Enderlen (Meerwein, *loc. cit.*) observed such a tumor after an abdominal traumatism and made the mistaken diagnosis of intraperitoneal hæmatoma. Berry and Guiseppi's first case showed, twenty hours after accident, a fixed tumor in the right upper quadrant, dull on percussion and continuous with the liver; since the patient had not the appearance of internal hemorrhage, a diagnosis of retroperitoneal rupture of the duodenum was made and confirmed at autopsy, no operation being undertaken. This is the only instance encountered of correct diagnosis. My own case showed a quite similar tumor discovered, however, only just before the abdomen was opened. Had I been familiar with this injury and its effects the finding of such a tumor should have led to a diagnosis.

Operative Results.—Of the 22 cases reported, laparotomy was made 20 times and in 1 case a retroperitoneal abscess was opened low in the axilla. Of the 21 cases operated upon but 3 recovered. No case survived when operation was postponed more than twenty-four hours; however, of the 10 cases operated upon within the first twenty-four hours, 3 recovered. Winiwarter, *loc. cit.* (Case No. 6), successfully sutured a traumatic subperitoneal rupture of the anterior wall of the third portion of the duodenum nine hours after the accident. In Wrede's (*Munch. med. Woch.*, 1914, vol. lxi, p. 846) successful case (No. 13), operated upon twenty hours after injury, the operator resected 2 inches of the third portion of the duodenum, closing both ends and making a retrocolic duodenojejunostomy. Niederle (Case No. 21) (Cosop, *lek. cesk., V. Prase,* 1915, vol. liv, pp. 31–36) successfully operated upon a case four hours after the accident, making a simple two-layer suture of a rupture at the junction of the second and third portions of the duodenum and a posterior gastro-enterostomy. Schumacher reports among 24 cases but 2 (Enderlen and Helfrich) in which operation was successful. Seven hours after injury, Enderlen (reported by Meerwein) resected the duodenum from just below the papilla to the duodenojejunal juncture, closed the ends, made a posterior gastro-enterostomy, and, the patient still being in good condition, anastomosed the first portion of the duodenum to the upper jejunum to provide exit for the bile and pancreatic juice; the patient recovered. Helfrich (reported by Hamann, Ein Fall von Ruptur des Duodenums durch Hufschlag. Dissertation. Kiel, 1907) made a successful suture of a rupture in the second portion of the duodenum; a duodenal fistula which developed after operation closed spontaneously. Thus among 45 reported cases of operation for retroperitoneal rupture of the duodenum, there are but 5 recoveries, a mortality of 89 per cent. There are a few cases of combined intra- and extraperitoneal rupture of the duodenum which were successfully treated by operation, but in such instances, the free intraperitoneal extravasation should produce earlier and more definite symptoms of peritoneal irritation than those following the lesion under consideration, and thus lead to earlier exploration and a lesser mortality rate.

Operative Methods.—When simple suture will suffice, it is obviously the method of choice. Elaborate procedures have no place here, since most of these cases are badly shocked and frequently collapse during the operation. However, it may not be possible to close the bowel satisfactorily by simple suture, especially when it is extremely torn, severely contused or necrotic; the choice then is virtually between drainage alone or resection and restoration of the continuity of the gastro-intestinal

tract. With such a lesion in the second portion of the duodenum above the papilla, the operation of choice would obviously be closure of the ends and posterior gastro-enterostomy. The only successfully treated extensive rupture of the third portion of the duodenum I can find was saved by resection with closure of the ends and retrocolic duodeno-jejunostomy. It is worthy of note that Schumacher recommended this procedure four years before the report of this case. Certain of these lesions in the third portion have been treated by closure of the ends and posterior gastro-enterostomy, but this forces the pancreatic fluid and bile to traverse the stomach before reaching the bowel, an obvious objection. With a widely destructive lesion placed in the region of the papilla, the difficulties are extreme. If it is possible to preserve the papilla intact it may be found feasible to close both ends, make a gastro-enterostomy, and implant the papilla in the upper jejunum. If the papilla itself has been destroyed, in theory the ideal operation would be that described by Kausch (*Zentralblatt fur Chirurgie*, 1909, No. 39) for cancer of the duodenum; in practice, no case yet reported has apparently been in shape to stand such an extensive procedure. Various compromise suggestions have been made—among others, ligation of both ducts with subsequent cholecystenterostomy and sacrifice of the pancreatic secretion. Considered broadly, even with extensive injury in the region of the papilla, it would seem probably wisest to attempt closure of the opening as much as possible by simple suture and trust to post-operative treatment of the resulting duodenal fistula. The successful case of Cheever (*Boston Medical and Surgical Journal*, 1915, vol. clxxiii, p. 454) emphasizes the possible advantages of such a method. It is to be said, however, that with a widely destructive lesion in the region of the papilla, the outlook is almost hopeless.

Methods of Approach.—If one encounters a typical retroperitoneal extravasation in a suggestive case, it is necessary to explore the retroperitoneal portions of the duodenum. The first and a greater part of the second portion of the duodenum is best exposed by Kocher's mobilization. To expose the third and fourth portions it is necessary to raise the transverse mesocolon, as is done preliminary to gastro-enterostomy; at the base of the posterior leaflet of the transverse mesocolon lie the third and fourth portions of the duodenum, covered only by the posterior peritoneum, incision through which renders the duodenum accessible to blunt dissection. The third and fourth portions, together with a considerable amount of the second portion, can be easily worked out of their beds and drawn down for inspection. It is, of course, necessary to avoid the right and middle colic arteries, which are plainly

visible in the mesocolon; Schumacher states that one can safely ligate the anastomotic branch between these two arteries. This method I have tried on the fresh cadaver and found that the greater portion of the duodenum can be readily exposed. The accompanying illustration

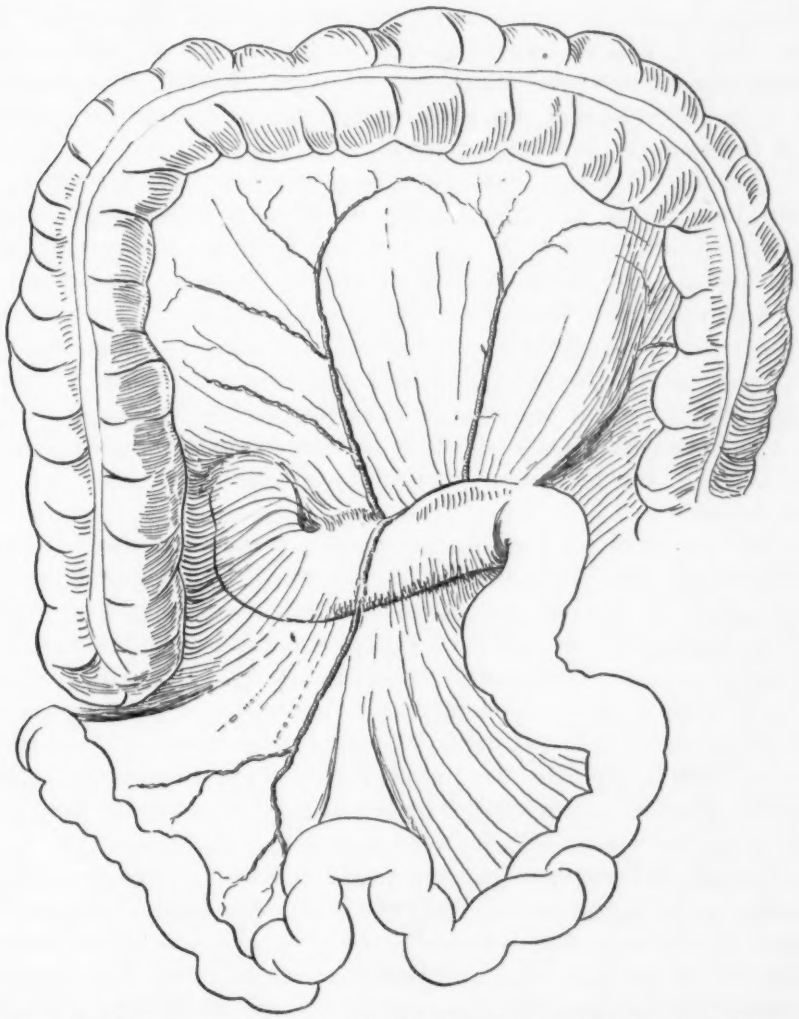

FIG. 5.—The transverse colon and mesocolon have been lifted, exposing a portion of the second and all of the third and fourth parts of the duodenum. To approach this portion of the duodenum, the posterior peritoneum is incised in an avascular area, giving immediate access to the duodenum.

(Fig. 5) shows the method of approach. Jeannel, in 1899, proposed this method, and the modifications subsequently made by Schumacher and Kanavel have served to emphasize its usefulness. Kanavel (*Sur-*

gery, Gynecology and Obstetrics, 1914, vol. xviii, p. 484) remarks that he has used this exposure as more or less of a routine in certain cases and found it quite successful, though associated with a rather marked degree of shock. When one is confronted with a typical retroperitoneal extravasation of this type, the procedure of choice is to raise the transverse mesocolon and immediately explore the third portion and the adjoining part of the second portion of the duodenum, since in this area occur the vast majority of such ruptures. Putting the mesentery on stretch by displacing the small intestine to the left of the abdomen will facilitate the procedure considerably.

Symptoms and Signs.—It is a striking thing that among these cases comparatively few are greatly inconvenienced by the original injury; very frequently remark is made that they walked home or that they were taken home. Few of them are rendered unconscious. Only a few vomit immediately and pain is in no sense marked. It is only upon the advent of the effects of extravasation that the symptoms become pronounced. Of 16 cases described fairly well, the most constant features are pain and tenderness, almost always generalized and usually maximum on the right side, about the umbilicus or in the upper quadrant. Occasionally the maximum pain and tenderness are to the left of the midline.

An occasional case has marked pain and tenderness in the right flank, in the right back, beneath the twelfth rib, or radiating to the right shoulder. Usually associated with this is corresponding spastic muscle protection, which follows the same general localization as that of tenderness (8 of 16 cases). Distention is usually present, together with vomiting. Dulness is not infrequently noted in the abdomen, generally in the right lower quadrant, or in one or both flanks. There is, of course, associated with this, limited abdominal respiration, rather marked increase in pulse-rate, recorded as high as 160 in one case, and a temperature which varies between 99 and 102.8°. A few cases have a subnormal temperature. Leucocytosis has been recorded very infrequently and it is practically of no great help. Among the odd features noted in symptomatology are retention of urine and occasionally marked cyanosis and lividity (1 case). In this connection may be mentioned a unique case of Berry and Guiseppi (No. 2), in which retroperitoneal rupture of the duodenum resulted in extravasation; the gas worked its way subperitoneally to the anterior portion of the abdominal wall, where it entered the peritoneal cavity by an independent tear in the peritoneum at that point.

The symptoms as outlined above are virtually the same as those observed in intraperitoneal rupture of the bowel and the same difficulty confronts one in determining whether or not a rupture is present. In general, however, it may be said that severe symptoms are delayed and make their appearance definitely by no means so promptly as with intraperitoneal rupture of the bowel. If diagnosis is difficult with intraperitoneal rupture of the bowel, it is doubly so with retroperitoneal rupture, because of the delay in symptoms. Kanavel observes that rigidity is not very constant with this lesion. In the light of this symptomatology, it is evident that if one waits for a definite diagnosis, the case is almost surely beyond help, hence, we are forced to choose the other horn of the dilemma and operate always in suspicious cases. There are probably few fields in which keenness of observation is at a higher premium than here.

CONCLUSIONS

1. Subcutaneous rupture of the duodenum forms 10 per cent. or more of the total number of subcutaneous ruptures of the bowel.

2. About one-third of the subcutaneous ruptures of the duodenum occur in its retroperitoneal portion and do not communicate with the peritoneal cavity, as a result of the primary injury.

3. In one-third of the reported cases, the lesion was not recognized at operation, though operation was undertaken on a diagnosis of probable rupture of the bowel. In contrast to this stands the fact that the findings at operation are distinct and practically pathognomonic.

4. The presence of a retroperitoneal hemorrhagic extravasation, occupying the root of the transverse mesocolon and more or less of the adjacent region, with a peritoneal cavity which is grossly clean, is practically pathognomonic of traumatic retroperitoneal rupture of the duodenum and with the presence of subperitoneal petechial hemorrhages and fat necroses over the ascending colon, transverse colon and mesocolon, presents a typical picture.

5. There is a mortality of 90 per cent. or more in this group of cases, as contrasted to an estimated mortality of 70 per cent. in subcutaneous rupture of the bowel in general.

6. The symptoms of such a rupture differ from those of intraperitoneal rupture very slightly excepting that the onset of severe urgent symptoms is somewhat slower.

7. In the fatal cases, extensive retroperitoneal extravasation is constant and together with the effects of duodenal fistula and duodenal toxæmia is, in part, responsible for the high mortality rate.

GROUP

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
1	Berry and Guiseppi, 1909, No. 49	11	M.	Run over.....	Conscious; no severe symptoms. Vomited twice. Pulse 110; respiration 26; temperature 97°. 20 hours after injury became unconscious. Pulse 162; respiration 40; temperature 102.4°. Abdomen rigid and tender. Dulness continuous, with R. H. D. extending to right linea semilunaris in front. Diagnosis made, namely, retroperitoneal rupture of duodenum, largely on dulness which could not be due to hemorrhage, since patient was not pale	No operation, too sick
2	Berry and Guiseppi (Pitt's case), St. Thomas	19	M.	Run over.....	2 hours after accident, shocked, restless. Pulse feeble. No vomiting. No shifting dulness. Emphysema of abdominal wall. Liver dulness absent. Distention. Severe pain	3 hours.....
3	Berry and Guiseppi, No. 118	52	M.	Squeezed between shaft of wagon and wall	On admission, shock. Upper half right rectus rigid. Tenderness about umbilicus. Dulness in right flank. Limited respiratory movements. Vomited 3 times. Pulse 68; temperature 97°. Vomiting, rigidity, distention and dulness increased	14 hours.....
4	Berry and Guiseppi, No. 132	A.	M.	Crushed between tailboard of cart and wall	On admission, limited respiratory motion, considerable tenderness over upper right rectus where hæmatoma was felt. Liver dulness present. No dulness in abdomen generally. No vomiting. Pulse 90; temperature 98.6°. Within several hours after examination, vomited several times. During second 24 hours, pulse 120, temperature 100.2°. Vomiting. Rigidity. R. H. D. present. About 24–36 hours, pulse 140; temperature 101°. Rigidity and tenderness marked. Vomitus fecal. Dulness of both iliac fossæ. Grew rapidly worse	About 30 hour (estimated)
5	Winiwarter, 1912, No. 1	52	F.	Struck in upper abdomen with handle of rake	Six hours after accident, collapsed. Free biliary vomiting. Diagnosis: Perforative peritonitis	24 hours.....

I

Lesion found at operation	Situation	Operative method	Result
No operation.....	.....	.....	Death in 3 days. Retroperitoneal rupture ¼ inch long—junction of parts 2 and 3. Retroperitoneal tissue infiltrated with pus and intestinal contents. No peritonitis. No ruptured kidney.
Mesentery, emphysematous. Rupture not found. Shock during operation	.....	Exploratory laparotomy	Death, 12 hours after accident, 8 hours after operation. Autopsy: Retroperitoneal rupture ¼ inch long, 2¼ inches from pylorus, junction of parts 1 and 2. Gas in retroperitoneal tissue, then to rent in anterior parietal peritoneum and so within peritoneal cavity. Emphysema, abdominal wall.
Rupture not found. Shock during operation, which was terminated	.....	Drainage.....	Death 16 hours after accident, 2 hours after operation. Autopsy: No peritonitis. Retroperitoneal rupture, two-thirds circumference, 5 inches from pylorus (part 2). Hemorrhage into mesentery and transverse mesocolon. Right kidney partially digested.
Rupture not found.....	.....	Extensive drainage. No mention of peritonitis made on operative note	Death 10 hours after operation. Autopsy: Retroperitoneal rupture of part 3 (behind mesentery, condition of post-peritoneum not stated). Fat necrosis, mesentery. No gas in peritoneal cavity, bile-stained fluid in pelvis, intestines covered with lymph. Right rectus ruptured.
Rupture found. Bile-stained fluid in peritoneal cavity. Hemorrhagic from root of transverse mesocolon to root of mesentery and toward right to reflexion of peritoneum over ascending colon. Incision over swelling. Fat necrosis and small hemorrhages in transverse colon, mesocolon and omentum	Part 3, proximal half, two-thirds circumference of bowel	Simple suture. Drainage	Death eighth day. Generalized retroperitoneal phlegmon, part 1 to pelvis, entire right side and extending into left. Tissues black and gangrenous. Pancreas not involved primarily.

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
6	Winiwarter, 1912, No. 2	42	M.	Kicked by a horse	Vomitus bile-stained. Helped home. Bowels moved. 8 hours after accident, moderate distention, marked spasm, great tenderness, especially on the right. Pulse normal; temperature 101.1°. Pale and anxious	9 hours.....
7	Knaggs, 1913, No. 1	24	M.	Kicked by player's knee near umbilicus at foot-ball	Immediate: "Knockedout," vomited, but recovered and was sent home by train. Pain in right abdomen, continuous after accident. Vomited everything eaten. Admission 24 hours after accident: marked tenderness in right lower quadrant. Abdomen rigid, especially right side. Liver dulness present. Dulness in right loin and right iliac fossa, "a fluid thrill could be obtained" (probably in right iliac fossa). Pulse 120; respiration 28; temperature 99°. "Marked leucocytosis" and hiccough. Did not "look" ill, but felt so	Soon after admission — 26 hours (?)
8	Knaggs, 1913, No. 2	20	M.	Struck near umbilicus by player's knee	Condition several hours later: Lips pale, but condition did not suggest grave injury. Pulse 80; respirations 32; temperature 97.8°. Vomited at examination once, thin brown fluid. Slight abdominal respiration. Liver dulness present. No distention or free fluid. Very slight pain. Slept little. About eighteenth hour: Vomitus contained blood (chemical test). R. M. better but not satisfactory. Pulse 109; respiration 28; temperature 99°. Possibly slight fluid in abdomen. Very thirsty. Twenty-fourth hour: Abdomen: early peritonitis. Pulse 120. Bile-stained vomitus. Moderate leucocytosis	About 26 hours.
9	Clark, 1913....	12	M.	Run over.....	Possibly vomited. Walked ¼ mile to hospital. On admission: Examination negative (abdomen). Next day: Vomiting	24 hours.....
10	Cope, 1913....	?	?	Struck in abdomen with pole	Increased pulse-rate, indication for operation	(?)
11	Kanavel, 1914, No. 1	?	M.	Kicked by horse in midline just below umbilicus	Fell. Conscious. Driven home. Vomited within 2 hours, fecal, not bloody. Black stool (medicine). Pain constant, no radiation. General abdominal tenderness, maximum in upper abdomen. 52 hours: Temperature 102.8°; respiration 46; pulse 120; white blood-cells 20,700	52 hours.....

Lesion found at operation	Situation	Operative method	Result
Rupture found. Peritoneal cavity clean. Slight amount of bloody fluid. Petechial hemorrhages of colon, ascending and transverse, and transverse mesocolon. Bloody gaseous tumor root transverse mesocolon	Part 3, anterior wall; peritoneum intact	Simple suture. Drainage	Recovery complicated by right retroperitoneal abscess from operative trauma to ascending colon. Ruptured into bowel.
Rupture not found. "Dark colored" fluid in peritoneal cavity. No gas or general peritonitis. Extensive retroperitoneal inflammation, right side to pelvis, left side in region of duodenojejunal junction. Most marked about ascending colon near pelvis and about duodenojejunal junction	.....	Closed without diagnosis	Death 2 hours after operation, from increasing toxæmia and heart failure. Autopsy: Retroperitoneal rupture size 3-penny piece, junction of parts 2 and 3. Retroperitoneal tissues and mesentery from right kidney and upper mesenteric attachment down both sides into pelvis emphysematous and infiltrated with bile and pus.
Rupture found. Dark fluid in peritoneal cavity. No general peritonitis. Right retroperitoneal tissues full of gas and pus from part 1 down behind ascending colon	Rupture. One-half circumference, 1 inch from pylorus, one-half posterior and one-half anterior surface on lateral and not mesial aspect. All retroperitoneal	Simple suture. Difficult and uncertain	Death 24 hours after operation. Pulse 144; respiration 44; temperature 1040. Autopsy: Large retroperitoneal abscess in right renal fossa. Liver dome adherent to diaphragm. Suture solid and firm.
Rupture found.....	Complete retroperitoneal division, part 3, with slight extravasation	End-to-end suture. Approach: Incision just below root of transverse mesocolon	Death with symptoms of intestinal obstruction (as before operation). Time (?). Advised closure ends and gastro-enterostomy.
Rupture found. Retroperitoneal emphysema	Large rent, part 2, retroperitoneal	Ends closed. Gastro-enterostomy	Death from pneumonia, having done well otherwise. Autopsy: Clean peritoneum.
Rupture found. Free bloody fluid in abdomen	Retroperitoneal perforation of pylorus with laceration of mesentery, part 2	Simple suture. Kocher's exposure	Death 6 hours after operation by toxæmia. Autopsy: Local peritonitis, but violent injection peritoneal surfaces and œdema of subperitoneal tissue.

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
12	Kanavel, 1914, No. 2	?	M.	Crushed in abdomen between wagon pole and telegraph pole	Vomited soon and again within 12 hours, then repeatedly. Severe epigastric pain, but continued to work. Examination: 34 hours after trauma: marked distention with general tenderness, maximum in right lower quadrant. Pulse 126; respiration 32; temperature 97°	34 hours.....
13	Wrede, 1914...	18	M.	Struck in abdomen with piston	Fainted. Immediate pain. Walked home. Great pain 2 hours later, constant and increasing. Admission 20 hours after accident: Temperature 99.6°; pulse 92, regular and strong. Anxious facial expression. No hiccough or vomiting. Examination, 20 hours after accident: Marked distention, extreme tenderness, maximum left of umbilicus, where also note impaired, otherwise tympanitic	20 hours.....
14	Maddock, 1914	25	M.	Plank dropped from ceiling on right side, struck eighth rib, midaxillary line	Dull aching pain for 3 weeks, pain then severe, especially on respiration. Swelling over rib. Fever every night. Examination 6 weeks after accident: Temperature 101.8°; pulse 100. Very ill, great pain, emaciated. Abscess over centre of eighth rib, right. R. H. D. 1 inch above costal margin. Abdomen distended, general spasm. Bowel movement free, but "chronic peritonitis"	6 weeks.....
15	Keller, 1914, No. 1	18	M.	Fall of 12 feet, striking right flank on bench	No vomiting; marked pain, right side, and 2 hours later had muscle spasm. Admission: Temperature 99.6°; pulse 154. Good color. Moderate distention. Slight general muscle spasm, right more than left. Dulness right flank. Diagnosis: Ruptured liver	12 hours.....
16	Lister (case of Marnoch), 1914	25	M.	Horse fell on rider's abdomen	No record given.....	Immediate operation
17	Cope, 1914, No. 19	16	M.	Crushed between cart and wall	Admission immediately: Abdomen immobile, tenderness over right rectus. Pulse 90; temperature 98°. Next day: Vomiting, pulse 140, abdomen tender, rigid, dulness both iliac fossæ. Fecal vomiting	More than 24 hours, less than 36 hours

Lesion found at operation	Situation	Operative method	Result
Rupture found. Clear, thin, bloody fluid. Intestines injected. Fat necrosis in hepatic flexure. Entire retroperitoneal tissue, including pelvis, filled with fluid, serum, bile and intestinal contents. Considerable swelling to right of spine	Longitudinal tear, 1½ inches on level of common duct and below, retroperitoneal	Simple suture. Drainage	Death after 50 hours. No vomiting. Bowels moving. Autopsy: No peritonitis. "Toxic death," yet temperature 103°, pulse 120–160 and respiration 44. Delirious.
Small hæmatoma in mesentery of jejunum at junction. Root of mesentery œdematous. Limited area retroperitoneal purulent infiltration. Stomach and transverse colon distended. Clear exudate about jejunum	Small perforation dorsal wall, part 3	Resection of about 1 inch. Closure of ends. Duodeno- (part 3) jejunostomy, retrocolic. Drainage through mesocolon	Very sick 8 days, then quick recovery.
No laparotomy. Drainage (resection of rib) of abscess of liver and subphrenic space, of intestinal origin	.....	Drainage.....	Death 1 week after operation. Autopsy: Retroperitoneal rupture of part 2, infection spread along eighth rib to liver and subphrenic space. Peritoneal cavity: serous fluid and masses gelatinous matter.
Rupture not found. Blood about liver. Swelling behind ascending colon with thin, "dark tea" like fluid. Condition poor. Operation stopped. Peritoneum clean	.....	Drainage.....	Death 5 days later. Autopsy: subperitoneal rupture, 3.5 cm. diameter, anterior surface junction of parts 2 and 3. General peritonitis from retroperitoneal abscess. Purulent mediastinitis and pleuritis.
Blood-stained fluid in peritoneal cavity. Subperitoneal hemorrhage, mesentery and omentum. Large retroperitoneal hæmatoma opened and drained Rupture not found	.....	Drainage.....	Death ninth day. Retroperitoneal rupture, transverse, of duodenum part 4. Retroperitoneal cellulitis. No peritonitis mentioned.
Rupture not found. Bile-stained fluid in pelvis, fat necrosis, peritonitis	.....	Drainage.....	Death 11 hours after operation. Autopsy: Retroperitoneal rupture of part 3.

No.	Reporter and date	Age	Sex	Injury	Symptoms and signs	Time between injury and operation
18	Cope, 1914, No. 25	29	M.	Knocked down by motor van	Not stated.....	Questionable; probably immediately
19	Cope, 1914, No. 35	15	M.	Crushed between cart and wall	Acute general abdominal pain. Tenderness and rigidity in right side. Abdomen "fixed." Vomiting. Temperature 96.8°; pulse 80–112	5 hours.....
20	Niederle, 1915, No. 1	17	M.	Kicked by horse to right of umbilicus	8 hours after accident: Pulse 84; temperature 101°. Great abdominal pain, maximum to right of umbilicus. Urine negative	8½ hours.....
21	Niederle, 1915, No. 2	44	M.	Struck on abdomen with piece of iron	Did not vomit. Fell, carried off. 3 hours after accident: Temperature 98.6°; pulse 86; respiration normal. Cyanotic, later livid. No blood in stomach contents (tube or vomit ?). Abdomen: Distended, painful, maximum to right or about umbilicus. R. M. limited. Retention urine, 250 c.c.	4 hours.....
22	Miller.....	21	M.	Kicked by a mule.	At first very slight pain, went home. Moderate abdominal pain after an unstated time. Negative course for 10 days, then vomiting, visible gastric peristalsis and altered facial expression. Pulse and leucocytes normal throughout. Temperature moderate	Tenth day.....

Lesion found at operation	Situation	Operative method	Result
Rupture not found. "Tear in mesentery"	.....	Drainage.....	Death few hours after operation. Autopsy: 2 small holes posterior wall, part 2, with retroperitoneal extravasation. Commencing general peritonitis.
Rupture found.....	Not stated.....	Suture of rupture. Gastro - enterostomy. Closure of pylorus	Death: Pneumonia and extensive retroperitoneal cellulitis.
Rupture found. Retroperitoneal hemorrhage behind transverse mesocolon. Incision (probably beneath transverse mesocolon), extravasation. Peritoneal cavity clean at operation	Junction parts 2 and 3. Two-thirds circumference ragged edges. Retroperitoneal	Simple 2-layer suture. Posterior gastro - enterostomy. Drainage	Death. Duodenal fistula on tenth day. Starvation. Death, fourth week, after pyloric occlusion.
Rupture found. Bloody fluid in peritoneal cavity, fibrin on small intestine, without sign of injury. Hæmatoma of omentum, also evident about duodenum, after transverse mesocolon raised	Junction parts 2 and 3. 4½ cm. in diameter	Simple 2-layer suture. Posterior gastro - enterostomy. Drainage	Recovery.
Rupture found. Retroperitoneal abscess	Part 2, 2 ruptures	D ainage.....	Death. Autopsy: 2 retroperitoneal duodenal ruptures, extensive retroperitoneal suppuration. Mild fibrinous peritonitis.

No.	Reporter and date	Age	Sex	Injury	Signs and symptoms
					GROUP II: RUPTURE OF GUT
	Lonhard, 1911....	23	M.	Crushed between railroad cars	1 hour after injury, admission. No urgent symptoms. 3 hours after injury, great pain, retracted abdominal wall with marked tenderness and spasm in left lower quadrant. Temperature 99.8°; pulse 100. Marked vomiting
					GROUP III: SIMULTANEOUS
1	Quenu and Mathieu, 1912	19	F.	Run over.....	1 hour: Pulse 110. Abdomen distended, tender, general muscle spasm. Drawn face
2	Favreul, 1913.....	20	M.	Crushed between wagon and wall	.....
3	Cheever, 1915.....	15	M.	Run over by auto.	Walked home, great pain. 1½ hours after accident: Pulse 50; blood-pressure 110; respiration and temperature normal. Slight shock, slight general tenderness and spasm. Maximum tenderness, left umbilicus. Dulness both flanks, not shifting. 4½ hours after accident: Pulse 84. Sicker. Abdominal pain. Marked tenderness in right iliac fossa, scarcely any in epigastrium. Vomited
					GROUP IV:
1	Keller, 1914, No. 2	27	M.	Struck on abdomen by board	Vomited, but walked home. Great pain in back. Abdomen soft. 12–18 hours later: Vomited twice, muscle spasm. Admission: Appearance good. Pulse 84. Abdomen: Muscle spasm and tenderness left hypochrondrium
2	Berry and Guiseppi, 1909, No. 63	15	M.	Run over, level of umbilicus	Collapse. Vomited once. No sign injury. Next day: Abdominal pain, frequent vomiting, pulse rapid and feeble

Time between injury and operation	Lesion found at operation	Situation	Operative method	Result
AND PERITONEUM WITHOUT PERITONITIS				
3 hours.....	Rupture not found. Peritoneal cavity clean, little bloody serum. Small area of ecchymosis of mesentery and bowel wall, midpoint small bowel. No free gas	.....	Closure.....	Death 16 hours after operation. Autopsy: Peritoneal cavity clean, no gas. 200 c.c. bloody fluid. Complete transverse tear of part 3, with rupture overlying peritoneum. The slightest, most limited inflammation of peritoneum adjoining. Retroperitoneal infiltration from right kidney into pelvis, bile-stained. No associated injury. *Cf.*, leak into peritoneal cavity prevented by overlying mesentery.
INTRAPERITONEAL AND RETROPERITONEAL RUPTURE				
1½ hours.....	Rupture found. Intestinal extravasation. Intraperitoneal rupture at junction of parts 1 and 2, anterior wall. Retroperitoneal rupture directly opposite	.....	Simple suture. Drainage of flank	Recovery.
1 hour.....	Rupture of jejunum found. Hemorrhagic infiltration beneath parietal peritoneum maximum at root of mesentery and about hepatic flexure	.....	Suture of rupture of jejunum, 30 cm. from duodenojejunal junction. Drainage of flanks	Death after 24 hours. Autopsy: Suture intact. Peritoneal cavity clean. Findings similar to operation and rupture of part 2, 2 cm. diameter, with intact peritoneum. Retroperitoneal extravasation, extent not mentioned.
8 hours.....	Rupture found. Free gas and blood in peritoneal cavity. Rupture intra- and retroperitoneal	Part 1, 3 cm. diameter, posterior wall, one-half within peritoneal cavity	Simple suture	Recovery.
INCOMPLETE RUPTURE				
About 24 hours, probably more or less	Free blood in peritoneal cavity. Fat necrosis omentum. Hæmatoma over right kidney and reaching into transverse mesocolon. Peritoneum opened, contusion pancreas, 3 cm. diameter. Contusion posterior wall, part 2	Part 2, posterior wall	Suture and drainage	Well, 7 weeks.
No operation..	.....	.....	.....	Death. Autopsy: Subcutaneous rupture of part 2. Large hæmatoma between muscularis and peritoneal coats, causing obstruction.

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CHRONIC APPENDICITIS AND ITS RELATION TO VISCEROPTOSIS*

By Archibald MacLaren, M.D.
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The operation for the removal of a chronic appendix is so common, and it is so often unsatisfactory to both the patient and the surgeon, that it has seemed to us wise and timely to enter into a short discussion of the reasons for this frequent disappointment. If the patient suffered no harm from the removal of a supposedly chronic appendix, or if there was no danger in the removal of a simple appendix, this question would not be so important. Every practising surgeon knows, or should know, as we will later show, that many patients are harmed by the operation for the removal of the so-called "chronic appendices," occasionally one dies as a result of operation; we have had at least one death, years ago, from the removal of a chronic appendix.

Now what do we mean by the term of "chronic appendicitis"? First, we are not talking about the relapsing type—a patient who has once had a true acute attack of appendicitis is always in danger, and even after years of perfect freedom is liable to have the old inflammation flare up again.

We do not believe in the chronic appendicitis *not associated* with at least one true acute attack. Of course, an attack of peritonitis may be due to any one of a large number of causes. If the patient never has had an attack of severe illness we have established one of the most important pieces of negative evidence with which to start our history of a case which we may be investigating. But suppose there has been a severe illness (of course, the patient frequently believes that the one acute attack of inflammation was something else than appendicitis), cross-examination will usually define the difference; if without suggestion to the patient we ask for a description of the "mild attack of typhoid," or the attack of "inflammation of the stomach, bowels or womb," we ought to be able to tell at least that there was or was not a true attack from some cause, even when we cannot locate its source. In our experience the patient is not able to be up and about with even a very mild attack of peritonitis, and with an attack of inflammation of the appendix, is practically always confined to bed and usually

* Read before the American Surgical Association, May 11, 1916.

has some vomiting. So that if we get a history that the patient was laid up in bed from three to five days, that there was vomiting, that the doctor found a rise in temperature, that there was pain on pressure or upon movement, we may feel sure that there was an attack of peritonitis. If the first of these two symptoms has not been present, the case under consideration probably did not have an attack of appendicitis. To-day every surgeon believes that he can distinguish between the true and the false—or neurasthenic imitation of appendicitis. It seems to us to be one of the most difficult surgical problems to make this diagnosis. The class of cases which we have in mind is well described by Mr. A. J. Walton in the *British Journal of Surgery* of October, 1915, under the title of "Clinical Aspects of Visceroptosis." Mr. Walton had 373 cases of true appendicitis in a period of four years; during the same time 67 cases of visceroptosis were subjected to abdominal exploration. These cases he divides into four groups:

1. Cases resembling appendicitis, both acute and chronic: acute 13 cases, chronic 16 cases, making a total of 29.
2. Cases resembling gastric ulcer, 27 cases;
3. Cases resembling gall-stones, 6 cases;
4. Cases resembling carcinoma of stomach, 5 cases.

These 67 cases were all practically errors in diagnosis, as is seen by studying the carefully reported histories of each case. The operations were not done for the purpose of correcting the ptosis, in fact, Walton, and every other surgeon of experience, concludes that the results of operative treatment in these cases are very unsatisfactory. These are the so-called neurasthenic cases, but no one, so far as we can find, has described this class of cases from the surgical point of view to our satisfaction. The surgeons all agree that the neurasthenic should not be operated upon, but they do not tell us how to distinguish between the case of true appendicitis and the neurotic counterfeit. Deaver, in his book on *Appendicitis,* gives the impression that it is easy to make a differential diagnosis between chronic appendicitis and the neurasthenic even when there has been no preceding acute attack. In Deaver's fourth edition, 1913, under the heading "Recurrent Appendicitis," he says, "The diagnosis of chronic appendicitis is usually clear. The plainer cases give a history of acute pain referred to the region of the appendix, and examination reveals definite soreness, and upon palpation over this region even in the absence of an acute attack a diagnosis may be made with almost invariable accuracy on this combination alone, *i.e.*, pain and tenderness in the right inguinal region." We are sure that this is not true, not only from our own ex-

perience but more particularly because we see so many uncured cases: cases with pretty appendicular scars, but whose symptoms are *worse rather than better*—cases that have been operated upon during the past two years, by good men, not only in the West but by well-known surgeons in the East as well.

Deaver says, " a normal appendix is a rarity in the adult." There are a number of pathological conditions which like chronic appendicitis are, to say the least, questionable, as for instance, Jackson's membrane, mobile cæcum, Lane's kink, one or all of which usually accompanies visceroptosis. Some surgeons and their pathological friends have assumed that these conditions are proved, and that they are surgical; we feel that they are not proved, and that it will take years of careful study to determine when they are surgical and when they are not.

We have all taken it for granted, for instance, that obliterative appendicitis was the result of, or produced by, an inflammatory state of the appendix. But when such good pathologists as Ribbert, Wölfler and Zuckerkandl, quoted by Kelly, after a careful examination of a large number of cases of obliterative appendicitis, all arrive at the conclusion that these conditions are not due to inflammatory changes, but were an involution process in a functionless organ; it makes us hesitate to accept other minor pathological changes in the appendix as important lesions. In a case of relapsing appendicitis the appendix is usually buried in adhesions, while in obliterative appendicitis it is often quite free with no adhesions about it at all. The neurasthenic, or visceroptosis case, sometimes simulates the acute, but usually is mistaken for chronic appendicitis. These, as a rule, are young women or girls from twelve to twenty-four years of age (occasionally in older women, rarely in men) who are not in good physical condition, have lost from 10 to 15 pounds in weight, are worrying over family or financial troubles, or over examinations at school; they are of the flat-chested, scaphoid abdominal type, and when it is necessary for them to stand a great deal are often flat-footed. They have pain in the head, back, pelvis, or abdomen due to their general debility; they complain of tenderness on pressure in various parts of the abdomen; many of them complain of this tenderness mostly in the right inguinal region, and these are the ones who come to us for operation. But just as large a number come to us on account of abdominal discomforts after their appendices have been removed. These cases, as Walton, referred to above, says, are frequently temporarily relieved but in a few weeks their old symptoms recur, as is shown in his histories. It has seemed to us that these neurasthenic cases are improved by our

unintentional exercise upon them of the faith cure. For if we honestly believe that we have removed the cause of their distress we do unconsciously exercise this power whether we believe that we do or not. It has seemed to us that this pain and tenderness in the right inguinal region, in these cases, was usually due to the stretching of the duodenum from its fixed point under the liver to the ptosed pylorus in the pelvis. There is seldom any rise in temperature, the pulse is normal as a rule; occasionally in the younger patients it is rapid from excitement, probably due to the examination. There is no true abdominal rigidity, and the pain in the abdomen in the chronic cases will be lessened or will disappear when the patient lies down. This last point has seemed to us to be perhaps the most important point in making a differential diagnosis between the true and the false appendicitis.

If the case which we have described is operated upon, what happens to her? The appendix is found to contain some slight evidence of disease, and, to-day, we believe that every appendix is pathologically condemned by some pathologist somewhere. We are always under these circumstances reminded of the pathological condemnation of every ovary and tube ever seen twenty years ago.

The operation is a success, the wound is perfect, but she has lost at least five pounds in weight, and when she is encouraged to get up and about, to prove what great surgeons we are, her headache in her abdomen comes back, sometimes in the same place, unfortunately it sometimes comes back somewhere else; then the inexperienced surgeon concludes that the pain is due to some other organic lesion which he has overlooked and advises some further operative interference. We have often heard that it takes a patient a year to recover from an operation for chronic appendicitis, which ought to prove that the operation was unnecessary, because it does not take anything like that length of time to recover from the removal of an acute appendix even after abscess formation.

All of us have seen these patients after they had suffered several laparotomies, as, for instance, we saw a few weeks ago a patient with eight scars on her abdomen who was provoked when we refused to remove her only remaining ovary, that being the only removable organ left in her abdomen.

If these patients are not operated upon what can we do for them? The internal medical man has been curing these patients for years by the "old-fashioned rest cure" process. Years ago we would advise an operation in consultation and find to our amazement that when the patient is rested and built up and had gained about ten pounds in weight

her abdominal distress had almost disappeared and that the abdominal or pelvic pains would not come back, unless for some cause weight was again lost. Even when these cases cannot give up their work and take a regular rest cure, on account of expense, a *modified rest cure* is better for them both physically and financially than a useless operation. Six fat meals a day and lying down every minute that they can get away from their work helps immensely. We have, at a moderate estimate, seen, in the last four or five years, 100 of these cases, some of them being sent to us for the purpose of having their appendices removed, some to find out what was the reason of their continuing ill health. Almost all of these cases have gotten well without operation, which to our mind is the acme of surgical success.

We have already pointed out in our study of gastroptosis presented to the American Surgical Society in 1911, that this type of patient was the one that we had previously operated upon, usually for chronic appendicitis, without effecting a cure. In that communication we were able to show by X-ray that the stomach was ptosed and atonic, that they still had their same point of pain and tenderness in the right iliac fossa even after their appendices had been removed.

We have taken for this study 225 consecutive operation cases, commencing January 1, 1906, operated upon in our own private practice, with the result that we find that there were 12 cases which were, we now believe, without X-ray confirmation, neurotic or gastroptosis cases. We give the following tables as a complement of this paper:

TABLES

1. Chronic appendicitis, woman, aged twenty-four years. No improvement two years after operation.

2. Gastric ulcer, woman, aged fifty-eight years. No improvement.

3. Chronic appendicitis, man, aged twenty years. No improvement.

4. Chronic appendicitis, woman, aged twenty-five years. No improvement three years after operation.

5. Chronic appendicitis, woman, aged twenty-five years. No improvement six weeks later. Gastro-enterostomy, two years later, died, perforated duodenal ulcer.

6. Chronic appendicitis and retrodisplacement, woman, aged twenty-four years. Dilatation for dysmenorrhœa; appendectomy and retrodisplacement operation, worse.

7. Chronic appendicitis, retrodisplacement, woman, aged twenty-eight years. No improvement in eighteen months.

8. Gastric ulcer, chronic appendicitis, three years ago; operation, cervix and perineum. No better one year later.

10. Chronic appendicitis, woman, aged nineteen years. No results one year later.

11. Chronic appendicitis, woman, aged thirty-six years. Operation for laceration of cervix and perineum, one year ago. Mucous colitis two years, few adhesions; Jackson's membrane. One year later no improvement.

12. Chronic appendix, woman, aged thirty-five years. No improvement.

Résumé: Eight cases of chronic appendicitis. Three cases of supposed gastric ulcer with one death, and one pelvic case.

We have then skipped six years and taken up our histories in the same way commencing January 1, 1912, the year after we had written on gastroptosis. In the next 225 cases we find that there were only six operative errors as against twelve of the six years before.

1912

1. Chronic appendicitis, Jackson's membrane, woman, aged twenty-one years. No improvement.

2. Pelvic chronic appendix, Lane's kink, woman, aged thirty-five years. No improvement.

3. Chronic appendicitis, girl, aged fourteen years, Jackson's membrane. No improvement.

4. Chronic appendicitis, girl, aged sixteen years, Jackson's membrane. No improvement.

5. Chronic appendicitis, woman, aged fifty-seven years. Blood in stools, Jackson's membrane. No result for two years.

6. Chronic appendicitis, girl, aged nineteen years. No result.

PSEUDOMUCINOUS CYST OF THE APPENDIX COMPLICATING RUPTURED ECTOPIC GESTATION

By Nathaniel Ginsburg, M.D.
of Philadelphia, Pa.

Pseudomucinous cyst of the appendix has occurred, according to the researches of Dodge, sufficiently often to make the collection and study of 142 cases possible. It is the belief of the writer that this condition, like many other surgical states, occurs with greater frequency than the literature leads one to believe. Reference to the paper of Dodge, appearing in the Annals of Surgery, March, 1916, affords a complete review of the subject. The writer desires to add the report of a case of cystic dilatation of the appendix occurring in a patient who was primarily operated upon for a circumscribed pelvic hæmatoma, the result of a ruptured right tubal pregnancy of some weeks' duration.

The patient, thirty-seven years of age, was admitted into the Jewish Hospital of Philadelphia on the writer's service in June, 1915, complaining of pain and tenderness in the lower abdomen and vaginal bleeding. Examination revealed a tumor occupying the right aspect and almost completely filling the pelvis, and giving the resistance to the examining finger of a cystic mass. In view of the patient's history, which was quite definite, exploration was done and a ruptured right tubal pregnancy with encapsulation was found. After dealing with the pelvic condition, the appendix was examined and found to be the type of pseudomucinous cyst first described by Virchow in 1863.

The following report of the appendix was dictated at the operation: The appendix is a sausage-shaped mass lying in the right iliac fossa below the cæcum, having a concave mesenteric border. The size can best be estimated by reference to the photograph. The meso-appendix consists of a thin peritoneal veil containing very small appendiceal vessels which were easily ligated by a single ligature. The peritoneal surface of the appendix is almost entirely avascular, and the wall of the organ is thinned out to a degree approaching veil-like transparency. The mucosa, completely atrophied to the muscularis, has entirely disappeared, owing to intra-appendiceal pressure. The serous surface is fairly smooth, and presents three distinct diverticuli in two or more places near the proximal end of the organ. One of these diverticuli is very large, almost the size of a small walnut,

lying close to the mesenteric border of the organ, and, where the wall is thinned out, presents a secondary out-pouching. The wall of the appendix appears to be thinner where the diverticuli exist, no doubt due to less mural resistance at this point. The appendix contains a thick semitransparent gelatinous material which is retained by an apparent closure of the proximal end of the organ. The entire appendix is involved in the process, and examination of the specimen definitely establishes mechanical closure at the cæcal end of the appendix. There are no adhesions or evidence of inflammatory disease contiguous to the appendix, since the appendix was not adherent to the right tubal mass which lay entirely below the brim of the pelvis.

Close questioning of the patient following the operation revealed the fact that there had been definite periods of right iliac discomfort preceding the onset of the tubal rupture, no doubt attributable to the cystic distention of the appendix in this region.

FIG. 1.

CYSTIC DILATATION OF THE VERMIFORM APPENDIX

By Stuart Graves, M.D.
of Louisville, Ky.

(From the Pathological Laboratory of the Medical Department of the University of Louisville and of the Louisville City Hospital)

Cystic dilatation of the vermiform appendix is sufficiently rare to warrant a report of three such specimens. In reporting one case recently in the Annals of Surgery, Dodge [1] very thoroughly reviewed the literature and tabulated reports of 142 other cases. As a result of his study of these he deducted the following conclusions:

1. That cystic dilatation of the appendix is a relatively infrequent condition.
2. That true hydrops of the appendix is rare. Probably less than 9 per cent. of all appendiceal cysts.
3. That appendix cysts are essentially retention cysts and of inflammatory origin.
4. That the condition by no means runs a symptomless course; symptoms being present in at least 51 per cent. of operative cases, and 24 per cent. of all cases.
5. That the contents of certain appendiceal cysts, when implanted upon the peritoneal surface, are capable of producing a condition of pseudomyxoma peritonei.
6. That certain appendiceal cysts present structural and clinical characters that seem to ally them with adenocystomata.
7. That carcinomatous changes occasionally take place in appendiceal cysts.

The accompanying photograph (Fig. 2) illustrates a specimen sent from the operating room to the laboratory of the Louisville City Hospital with a clinical history in brief of five typical attacks of appendicitis during a period of three years. The patient was a white male, twenty-one years old. At operation the banana-shaped, dilated, cystic appendix was found free from adhesions and attached in normal position by a short, cord-like base which was twisted about one-third. This cord was ligated, the appendix was removed as usual, and the patient made a speedy and uneventful recovery. The gross examination showed the following:

Specimen consists of a banana-shaped appendix measuring 16.5 cm. along its distal border and approximately 3.5 cm. in greatest diameter. About 5 cm. from proximal end it is bent toward mesenteric border to make an angle of 120 degrees. Organ is pale, tense, thin-walled, fluctuates and

[1] Dodge, George E.: Cystic Dilatation of the Vermiform Appendix, Annals of Surgery, March, 1916.

apparently is distended with translucent fluid. Beneath serosa tortuous, dilated capillaries stand out prominently. No adhesions or diverticula are found. Peritoneum is everywhere smooth and glistening. Distal half of mesenteric border bears moderate amount of fat covered with intact peritoneum, while proximal half presents cut meso-appendix. Proximal end terminates in a cord-like stump, 6 mm. in diameter and 15 mm. long, which is ligated with a catgut suture. After fixation in Kaiserling fluids a cross-section of this stump proximal to ligature reveals pale, firm, solid tissue in which no lumen is apparent. On gentle compression of cyst no contents can be expressed after ligature is removed. When specimen is slit open along mesenteric border, thin, watery, translucent fluid escapes. Inner surface is everywhere pale, flat and smooth, but is not so smooth and glistening as serosa. No opening can be found in pedicle, although inner surface slopes toward centre of this in a conical depression. Wall measures from paper thinness to 2 mm. in thickness.

Microscopic Examination (Fig. 1).—Section of proximal portion of pedicle shows mucosa obliterated and replaced with fibrous tissue. Organization tissue and muscularis are infiltrated with leucocytes among which lymphocytes and plasma cells predominate largely. Section through base of pedicle where it broadens into cyst shows usual wall of appendix with mucosa, submucosa and muscularis, being also moderately infiltrated with lymphocytes and plasma cells chiefly. Section of wall of cyst shows a thin lining of epithelial cells, the remains of mucosa. In this an occasional shallow pocket is seen into which lining epithelium dips. Muscularis is much compressed and attenuated and infiltrated slightly with lymphocytes and plasma cells.

Microscopic Diagnoses.—(1) Pedicle: healed, obliterated appendix. (2) Wall: compressed appendix wall with slight chronic inflammation.

The cystic dilatation of this appendix evidently followed an inflammatory process which was more or less localized in the proximal end of the organ and resulted in obliteration of the lumen at that point. Continued secretion on the part of the mucosa in the remainder of the organ led to an accumulation of retained fluid which gradually distended the lumen until pressure caused the thinning and atrophy of the wall as found. Unfortunately no cultures could be made in the laboratory without damaging the specimen for museum purposes, as it had not been kept under sterile conditions after removal. Consequently there was not any opportunity to try to determine the exact etiological agent.

Dr. W. C. Dugan, of Louisville, who operated in this case, states that he has removed two similar appendices, one about 25 per cent. larger and one considerably smaller. In both of these cases the patients had been subject to typical attacks of appendicitis and each recovered uneventfully after appendectomy. In all three cases Dr. Dugan noted that no adhesions had been formed, indicating a lack of any great amount of inflammation in the distal portions of the appendices.

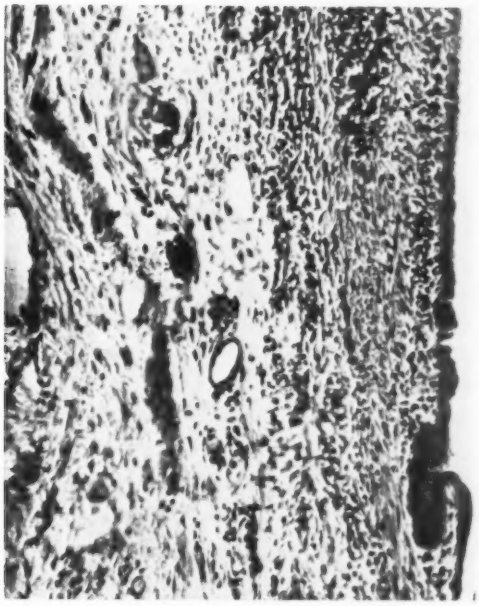

FIG. 1.—Photomicrograph of section of cyst wall. Note thinned mucosa and small pocket which is evidently the remains of a gland (x200). (Photo by L. S. Brown, Massachusetts General Hospital.)

FIG. 2.—Cystic dilatation of vermiform appendix.

MAJOR SURGERY UNDER MINOR ANÆSTHESIA*

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Much of the danger from every major operation is the danger of the anæsthetic. Much of the post-operative morbidity, many of the post-operative complications, and many of the post-operative deaths are due to the anæsthetic. In intra-abdominal operations, most of the post-operative distention, both gastric and intestinal, much of the vomiting, much of the pain, of the inability to move the bowels, of the shock, cardiac depression and many of the other so-called post-operative complications, are in reality post-anæsthetic sequelæ. With some operations the mortality is appreciably higher if a general anæsthetic is used. Take, for example, gastrostomy for malignant stricture of the œsophagus. This comparatively simple operation has a relatively high mortality when done under ether. I can recall numerous deaths after this operation done under ether, some at my own hands, some at the hands of colleagues. Some of these patients were in comparatively good condition, and I was on several occasions struck by the fact that death was probably due to ether pneumonia. Of late I have been doing gastrostomy and jejunostomy under novocaine, and there is a striking difference in the post-operative course; and, moreover, the operations can be done painlessly. Twice in the past few months I have done a Kader gastrostomy and once a Witzel jejunostomy under local anæsthesia. In each case I had an anæsthetist present and in each case the patient declined to take ether during any stage of the operation; and all these patients, run down by inoperable carcinoma, assured me that the procedure was quite painless.

How often are we confronted by patients who we say are bad operative risks, when we mean they are bad anæsthetic risks. Take some of these patients and give them ether for forty-five minutes or longer, and do no operation on them at all, and they will have a stormy time for several days, and some of them might even die as a result of the anæsthesia. Very recently I had a trying experience of this kind. A man of fifty-two fell and a radiograph taken four days later, when I first saw him, showed a fracture of the neck of the femur with outward rotation of the foot. There was no previous history of diabetes but

*Read before the New York Surgical Society, May 10, 1916.

we found albumin, casts and glucose in the urine. He was given anæsthesia just long enough to put the fragments in good position, and apply the Whitman plaster-of-Paris splint in abduction. Immediately following the anæsthesia he developed a marked acidosis, and in spite of all treatment died in coma a week later.

It is a well-known fact that patients are much less uncomfortable and have less post-operative complications after a short than after a long operation. This means they have had less ether and therefore are less sick. If we take away the ether altogether, or do only a small part of the operation under ether, is it not natural to expect a much smoother convalescence? Some years ago I looked up all the operations on the gall-bladder and ducts, done during the same period of time by several surgeons working at the same hospital. I found that there were seldom any complications after short operations, whereas the patient who had received ether for more than an hour frequently had a stormy convalescence. A full dose of morphine should precede operations under local anæsthesia. In prostate cases I give morphine by hypo and an opium suppository a half hour before operation. In appendix cases of late I have been giving two injections of morphine, one an hour before operation and one fifteen minutes before operation. I gave up spinal anæsthesia some years ago because the last patient upon whom I used it had complete incontinence of fæces and retention of urine lasting six weeks. In former years I used cocaine, stovaine, eucaine, and alypin, but have given them all up on account of the great advantages of novocaine. It does not irritate the tissues, even in strong solutions; and even in large doses it has no depressing effect on the heart. I have repeatedly used as much as 240 minims of a 1 per cent. solution and have never seen any bad effects therefrom. Others have reported using 20 c.c. of a 2 per cent. solution, while Braun goes so far as to say that 250 c.c. of a 1 per cent. solution can be used with safety in adults. Personally I have never used more than a quarter of that amount. In very vascular tissues, such as the gums, smaller amounts should be used.

But novocaine alone is not nearly as satisfactory as the combination of adrenalin and novocaine. This combination is what I prefer to use in all operations under local anæsthesia, and in my experience it is the most safe and satisfactory local anæsthetic that we to-day possess. The adrenalin not only increases the action of the novocaine but it appreciably prolongs the time it acts. On mucous membranes, however, novocaine is not nearly as efficacious as cocaine.

Novocaine can be sterilized, either by boiling, or by placing the solu-

tion contained in a bottle in the sterilizer with the dressings and leaving it there fifty minutes. The mouth of the bottle should be stopped with absorbent cotton to prevent excessive evaporation of the solution. To prevent its decomposition the ordinary solution of adrenalin usually has added to it hydrochloric acid and some antiseptic such as thymol. In this form the adrenalin solution can be sterilized by heat, and, if placed in a dark bottle, can be kept a long time; the addition of any alkali will tend to cause decomposition of the adrenalin. But in the tablet form both adrenalin and novocaine keep very much better than in solution. It is difficult to sterilize the tablets; they should be dissolved in water and sterilized just before use. I usually make up enough for each operation separately.

Lennander has shown both at operations and experimentally that the principal parts of the abdomen that are sensitive are the anterior and the posterior parietal peritoneum, pelvic peritoneum, and the peritoneum covering the diaphragm as far as it is innervated by the spinal nerves. The visceral peritoneum, stomach, intestines and omentum, even in the presence of acute peritonitis, and the peritoneal covering of the gall-bladder, liver and kidneys, are quite insensitive. This does not mean that pulling on these organs may not cause pain, and even other sensations such as nausea or a feeling of faintness. I have not always found the omentum free from sensation and prefer always to anæsthetize it before dividing it. The stomach and intestines are not sensitive, but I usually prefer to anæsthetize the mesentery before ligating it, just as I always inject novocaine into the mesenteriolum of the appendix before ligating it and cutting across the appendix. But I have always found the wall of the stomach and of the intestines entirely free from sensation; neither have I ever noticed any pain in cutting across the base of the appendix. The mesentery is often very sensitive, although in doing intestinal resections in strangulated herniæ it is not necessary to anæsthetize the mesentery. But the reason for this is that the mesentery has lost its sensation as a result of the prolonged strangulation. The sensations caused by pulling on any of the abdominal organs or by clamping or tying off the mesentery are very different from the sensations of pain. Some patients cannot localize these sensations, and some say they are almost unbearable unless the mesentery is anæsthetized; some patients complain of nausea and faintness. Lennander and Braun both found that the fundus of the gall-bladder can be clamped and cut without causing any pain, but if an attempt is made to pull the gall-bladder forward, or if the ducts are probed, pain will be elicited. Tying off the cystic artery or the cystic duct causes pain. Incising the

liver is not at all painful. Introducing and removing large gauze packings is distinctly painful. But I can say from personal experience that the opening and closing of the abdomen and the removal of the appendix or ovary, gastrostomy, cholecystostomy, and intestinal resections can be done painlessly under local anæsthesia.

Hernia.—For years I have occasionally been operating on inguinal, femoral as well as umbilical herniæ, under local anæsthesia, but of late, especially with my private cases, I am offering local anæsthesia to all of them, and most of them accept it. I have repeatedly operated on umbilical herniæ without ether, several times in very nervous patients, and have had no difficulty whatever. Some of these patients have had previous operations under ether, and they all noticed the remarkable increase in post-operative comfort. In inguinal herniæ it is advisable to block the iliohypogastric and ilioinguinal nerves near the upper end of the skin incision. Each layer should be anæsthetized separately, and novocaine should be injected into the neck of the sac, and also into the omentum if it is to be resected. That an extensive intestinal resection can be painlessly done under novocaine, the following case will clearly show:

> Frieda N., sixty-nine years old, was admitted to the First Surgical Service of Mount Sinai Hospital, January 12, 1916. Twenty-four hours before admission, after taking a cathartic, she had had a sudden cutting pain in the hypogastrium, and a mass appeared on the left inguinal region. She had vomited three times, the pain had persisted, and she was unable to move her bowels. On admission a very tender swelling, the size of a hen's egg, was found in the left inguinal and femoral region. Attempts at reduction, both before and after admission to the hospital, proved ineffectual. I undertook the operation shortly after admission. On opening the sac it was found to contain some bloody fluid and a loop of necrotic small intestine. There was no pulsation in the mesentery, and to ascertain the viability of the gut the mesentery was cut at right angle to its vessels. The mesentery was incised two inches to one side of the necrotic gut and four inches to the other side before active bleeding was encountered. Ten inches of gut were removed, the ends of the gut crushed and ligated, and each stump buried with two rows of linen sutures. A typical side-to-side anastomosis with Connell linen sutures was done. The typical Bassini operation for femoral hernia was then carried out. The operation consumed one hour and fifteen minutes and had been preceded by a full dose of morphine. Novocaine and adrenalin made the operation entirely painless, and at no time

did the patient complain of any pain. She made an uneventful recovery. In view of her advanced years and the extensive operation that was necessary, a general anæsthetic would have been associated with considerable danger.

Appendix.—During the past year I have been developing a technic for removing the appendix under local anæsthesia and have had eighteen cases which I have reported in the *Jour. A. M. A.* of April 8, 1916. To quote: "The first great objection will be the difficulty in dealing with adhesions. The adhesions we find are of two classes, fibrous and omental. The fibrous adhesions are not sensitive and can be readily divided. The omental adhesions can be readily anæsthetized by injecting into them a few drops of local anæsthetic. In a few minutes the adhesions can be ligated and divided without any pain. A few of my cases have been acute, one an empyema of the appendix; the remaining cases have been subacute or chronic. The right tube and ovary can be drawn into the wound and can be resected or excised if necessary. I hope in the near future to use this method in more and more acute cases, even in the presence of peritonitis. In fact, a peritonitis, far from being a contra-indication to doing the operation under local anæsthesia, will, I hope, soon be an indication for this operation. When we consider that the system is already struggling to throw off a peritoneal infection and that the organs of excretion are doing a large part of this defensive work, the danger of handicapping these organs still further by giving an anæsthetic is apparent to us all. And if we can remove an offending appendix in the presence of a peritonitis under local anæsthesia, we are giving our patient a far better chance for a rapid recovery.

"There is another important point. We all know how peristalsis is inhibited after abdominal operations under ether, and how serious a complication tympanites may become. In the cases in which I have operated under local anæsthesia, there has been very little or no tympanites, and peristalsis has been little, or not at all, inhibited. In a recent case of empyema of the appendix in a young woman, gas began to be passed fifteen hours after operation, and at no time was there any abdominal discomfort; nausea, vomiting and tympanites were entirely absent. In another recent subacute case the patient was reading the newspaper on the day after operation.

"Three of my cases were intelligent private patients, and the remaining cases were from the First Surgical Service of Mount Sinai Hospital. Each patient was asked if he or she was willing to have the operation done under local anæsthesia. Some of the patients were neurotic women, but most of them were fairly intelligent. Of course, the coöper-

ation of an intelligent patient is an advantage, and I would hesitate to do the operation on a young child.

"I was led to do this work by the following case:

> "Mrs. W. M. R., a patient of Dr. Alfred Schwab, had an acute attack of appendicitis in March, 1915. She had a bad heart, with pulse up to 120, a marked nephritis, enlargement of the liver and ascites. When I first saw this patient with her doctor I refused to operate on her. On the following day the symptoms of acute appendicitis became more severe, and I decided to try to remove the appendix under local anæsthesia. The patient, a very intelligent woman, kept up a running conversation with us during the operation; and, when it was completed, she assured us that the pain had been trifling. I saw this patient recently and she was in a very good condition. Had the operation been done under ether I fear we would have had a far different result.

"With increasing experience I have modified the technic somewhat. In my earlier cases I used the local anæsthetic only in the abdominal wall. But we found that most patients complained, either when the appendix was being drawn into the wound, or when its mesentery was being ligated.

"The technic which I now employ is as follows:

"Half an hour before the operation the patient receives a quarter of a grain of morphine hypodermically. I usually use a 1 per cent. solution of novocaine, to an ounce of which 20 drops of 1:1000 solution of epinephrin are added. As much as 240 minims of this solution can be safely used for an adult, which would correspond to about 2½ grains of novocaine. As a matter of fact, I have never found it necessary to use anything like that amount to do a painless appendectomy.

"I have for years had a personal preference for the muscle-splitting McBurney incision, and use it in most of my cases, acute as well as chronic. This incision lends itself particularly well for the operation under local anæsthesia. The skin near the anterior superior spine is not very sensitive; but by far the greatest advantage of an incision in this location is the fact that it comes right down on the cæcum. Rarely is it necessary to pack away the small intestines (although this can readily be done without causing pain), and there is thus less handling of the intestines. I first inject the novocaine solution into the skin along the line of proposed incision. In doing this I try to blanch the skin with the injected solution. Then I inject under the skin, along the same line.

" After a wait of three minutes, the skin and subcutaneous tissues are painlessly incised down to the aponeurosis of the external oblique. A sharp scalpel is used for dividing all layers, as scissors, being blunter than a knife, are more apt to cause pain. I next inject novocaine under the external oblique aponeurosis, and after two minutes divide it. The solution is next injected into the internal oblique muscle, parallel to the fibres of the muscle.

" After another wait of a few minutes the internal oblique is cut parallel to its fibres. We then inject a little novocaine under the peritoneum and wait fully three minutes before dividing it. If done in this way, there will be no pain up to this point. All manipulations should be as gentle as possible, on the part of the operator and of the assistants. Only a sharp scalpel should be used in dividing the various layers of the abdominal wall. It is rarely necessary to apply artery forceps in opening the abdomen through this incision, which is an additional advantage, as the crushing of the blood-vessel with forceps may cause some pain, unless the novocaine is injected around the vessel. If necessary a packing can be introduced to keep the small intestines out of the way, although it is rarely necessary with this incision.

"As soon as the cæcum with the appendix is exposed, the novocaine is injected into the mesenteriolum. If this is not done, and I omitted to do it in my earlier cases, the patient will complain of cramp-like abdominal pain referred to the navel or pit of the stomach. By anæsthetizing the mesenteriolum this pain is obviated. After a wait of three minutes the appendix can be pulled out of the abdomen, the mesentery ligated and divided and the appendix removed with almost no pain. It is not necessary to inject novocaine into the base of the appendix before ligating and removing it. If the mesenteriolum is properly anæsthetized, there will be no pain during the removal of the appendix. It is perfectly feasible to draw the right tube and ovary into the wound and do any operation on them that may be indicated. The abdomen is closed layer by layer in the usual manner, and, if the technic has been correct, the closure of the wound is entirely painless.

" I have kept a record of the statements of the patients concerning the amount of pain they felt during the operation. Most hospital patients will say that they felt some pain, but much less than they expected. My three private patients have all assured me that the operation was quite painless.

" The post-operative course is of much interest. A few hours after operation there is a little wound pain which is readily controlled by codeine or morphine. Peristalsis is regularly established early, in from

fifteen to twenty-four hours, so that the troublesome and painful post-operative distention is completely absent. I have recently had an acute case in which, during the entire convalescence, no rectal tube was inserted and no enema or cathartic was given. This patient had not the slightest sign of nausea, had fluids up to a few hours of the operation, and continued to take fluids after operation; yet the operation was done in the acute stage, and pus was found inside the appendix. Almost all of the patients have been able to take and retain fluids within a few hours after the operation. The post-operative depression so common with ether is entirely absent. Most patients are reading on the day after operation, and are sitting up in bed on the third or fourth day; in short, smooth and rapid convalescence, even in the acute cases, is a most striking phenomenon. The patients are usually able to get out of bed on the fourth or fifth day, and are ready to leave the hospital between the seventh and ninth days.

"I have described the operation as done through an intermuscular incision, but the operation can also be done under local anæsthesia through any other incisions for removing the appendix. For the reasons stated above, I believe the incision I have used to be the most desirable."

Prostate.—I believe I was the first to advocate and to practise the removal of the prostate gland through a suprapubic incision without ether or chloroform. In my original paper on "Suprapubic Prostatectomy under Nitrous Oxide Anæsthesia," published in 1904, I stated, "The chief contra-indications to the performance of prostatectomy have until recently been the dangers resulting from, first, the general anæsthetic; second, hemorrhage; third, shock. By the use of laughing-gas, the great objection of a general anæsthetic is at once removed. If, in addition, we do rapid work, then all three of the objections are removed. A prostatectomy, done under nitrous oxide in from eight to fifteen minutes, is not accompanied by any danger from the anæsthetic; the hemorrhage in those few minutes is very moderate and there is no shock. Many surgeons have held that a man unfit for general anæsthesia is unfit for prostatectomy. In view of our experience with laughing-gas are we not justified in asserting that view is erroneous?"

In 1903 I did my first two-stage prostatectomy, using laughing-gas for the first as well as for the second stage. Since then I have been gradually increasing the percentage of cases in which I do the two-stage operation, until in the past few years I carry it out in every case, using local anæsthesia for the first stage, and nitrous oxide for the second. There cannot be any doubt in the mind of any surgeon who has done the operation repeatedly in one stage and in two stages that the mortality

in a series of cases will be lower with the two-stage operation. I cannot bring myself to agree with those surgeons who do the operation in one stage if the patient is in good condition. After a moderately large experience in these cases, and from what I have observed of them at the hands of others, I have come to the conclusion that we are rarely in a position to say that any of these old patients is in "good" condition. And no matter how carefully we examine these cases before operation, no matter how many tests we make to determine the functional capacity of the kidneys, we are never in a position to state with assurance which one of these patients will be able to overcome the shock of operation. So to my mind the only safe thing we can do is to lessen the shock as much as possible in each and every case, whether the patient appears to be in good condition or not. And the shock of operation can certainly be lessened by doing the operation in two stages, using novocaine for the first stage, and laughing-gas for the second. I am glad to be able to say that I have never used ether or chloroform in any prostatectomy, and it goes without saying that I have never had an ether pneumonia in this class of cases. It has been my experience that some of these patients who seem the poorest risks will go through the operation, done in this way, with the most surprisingly smooth convalescence, while some who seem excellent risks are often badly shocked by a simple cystotomy. I know of no other safe rule than to consider all these old men bad risks and to give them the benefit of every possible safeguard, they need them all. As I said in a former paper, "Few surgeons will deny that in desperate cases the two-stage operation is safer; but they will tell you in good cases it is not necessary. And that is where the danger to the patient lies, that he will be taken for one of the "good" cases. And unfortunately some of these good cases, after a prostatectomy, turn out to be anything but good."

Empyema.—Simple incisions, even extensive resections of the ribs, can be done under local anæsthesia. The parietal pleura is sensitive but is readily anæsthetized. The pulmonary pleura, like the visceral peritoneum, is not sensitive, and the same can be said of lung tissue. Even in children one or more ribs can be readily removed under novocaine.

Subphrenic Abscess.—I have repeatedly opened such abscesses under local anæsthesia. The most recent case I have had was that of an old lady who had many of the symptoms of subphrenic abscess, but repeated aspirations by various men failed to show pus. The radiograph showed a large shadow in the region of the right subphrenic space. Under local anæsthesia, I resected the eighth rib in the axillary line and sewed the two layers of pleura together. I then aspirated through the diaphragm,

found pus, and opened an abscess containing at least eight ounces. The operation, done under local anæsthesia, presented no difficulties, and the patient made a good recovery.

Bones.—Periosteal and bone sensibility varies greatly with different individuals; thorough anæsthetizing of the periosteum very much lessens this sensibility. I recently had an old gentleman of sixty-two referred to me who had a marked endocarditis not well compensated, and both his physician and his children were very much opposed to his taking ether. He had an infected bunion which had been opened, and resulted in an extensive infection of both the adjoining phalanx and the metatarsus, and there was also extensive cellulitis of the foot. I did not think I could do a painless operation under novocaine, but as the family was insistent, I undertook it. I made incisions on the dorsal and plantar aspects of the foot to drain the cellulitis, excised the infected bursa, resected the base on the phalanx of the big toe and also the head of the metatarsus, which was badly infected. I used novocaine freely in the soft parts, after applying a Martin bandage to the leg, and I was careful to inject novocaine under the periosteum of the phalanx and of the metatarsus. At no time during the rather extensive operation did this old gentleman complain of pain.

Varicose Veins.—I have repeatedly removed even extensive varicose veins under novocaine. If a Martin bandage is applied, the action of the local anæsthetic is even more efficacious. The following case was a most unusual one:

> Miss K., a trained nurse, after lifting a heavy patient, had suddenly noticed a swelling in her left groin. Immediately thereafter she had vomited and fainted. She was employed at that time in one of the German University clinics. The attending surgeon diagnosed femoral hernia, and she was given ether preparatory to having it operated on. Before the operation had been started she collapsed, and was resuscitated only with great difficulty. No operation was attempted and she was told that she should never try to take ether again. For ten years following this experience a small swelling remained in the groin but did not cause much discomfort. She then began to have pain in the left leg and thigh at frequent intervals, with occasional swelling of the foot and leg. During all this time the diagnosis of femoral hernia was adhered to. I first examined this case eighteen years after the onset of the trouble. I found a small elastic swelling in the left groin just below Poupart's ligament. It was quite tender and not reducible. There was no evidence of any varicose veins and I concurred in the diagnosis of irreducible femoral hernia. At the operation done under local anæsthesia I was very much sur-

prised to find that the swelling consisted of the enormously distended common femoral vein which was filled with a firmly organized clot. I resected the vein and the patient made a good recovery, and has had no further trouble.

Combined Local and General Anæsthesia.—How often are we confronted by the question whether a given patient can stand an operation, whereas the question really is, can this patient stand a prolonged anæsthetic? Many patients of advanced years, many cases of cardiac and renal disease, fall into this class. And there can be no denying that the amount of ether that is given in one of these cases bears a very important relation to the prognosis. The following case is a striking example:

Mr. K., forty-nine years old, had had several attacks of cholecystitis. He had had two attacks of angina pectoris, had albumin and casts in the urine, a blood-pressure up to 190, and he had been told by several physicians of his various organic lesions. One consultant advised him not to be operated on, chiefly on account of the danger of an anæsthetic. After a rather severe attack of cholecystitis, I obtained his consent to operation on condition that I would do as much of the operation as possible under local anæsthesia. With novocaine I made a ten-inch cross-incision below the free border of the ribs, divided the rectus and oblique muscles, and opened the peritoneum without causing the patient the slightest pain. He testified to this at the time and also later. When I began to put in packings to wall off the very much enlarged and thickened gall-bladder, he began to complain of pain. A skilled anæsthetist then gave him gas and ether for about 15 minutes, during which time I separated and removed an adherent gall-bladder with stones, and sewed up the end of the cystic duct. The anæsthesia was then stopped and the abdomen closed. This patient did not vomit once during the first 48 hours after operation, there was no sign of shock, and he required no heart stimulants. His kidneys caused us no concern at any time. In spite of all the handicaps this man was laboring under, he made a prompt and good recovery. All of the gentlemen associated in this case believe that the patient owed his recovery, at least in large measure, to the short time he was under ether.

Does not such a case open a wide field of usefulness for combined local and general anæsthesia? Have we not all had operative deaths in this class of cases that could have been avoided?

I have made no attempt to cover the entire field of operations under local anæsthesia, but have rather tried to show some of the work that can

be satisfactorily done. The advantages of this kind of work will, I think, be apparent, from what has been said above. There can be no doubt that since major operations under local anæsthesia are still in their infancy the future holds a wide field for their development. Personally, I look forward to doing more and more operative work in this manner; and I am looking forward with considerable enthusiasm to doing more work with the combined local and general anæsthesia. Who will deny that it is a great advantage to do a difficult cholecystectomy with only fifteen minutes of ether? And how much ether we can save in a pylorectomy case that often takes one and one-half hours or even longer to perform. All of the suturing of the stomach and intestine, the opening and closing of the abdomen can be done painlessly under novocaine. And will we not have an appreciably lower mortality with many complicated abdominal operations if we reduce the time of anæsthesia to a small fraction of what it now is? We will often be able to get along with a short gas and oxygen anæsthesia, combined with local anæsthesia, in cases where we now use ether for forty-five minutes or longer.

Are there any inherent objections to operations under local anæsthesia? Surely there are. First, is the fear of causing pain. With increasing experience, with proper technic, with proper selection of cases, by combining local with brief general anæsthesia, pain will in large measure be eliminated. And even if pain were not entirely eliminated in some cases, the lessened danger of the operation, the fewer post-operative complications, the wonderful difference in post-operative comfort, would weigh heavily in favor of such procedure. That operation under local anæsthesia takes more time is true; but if we figure ten or fifteen minutes to get the patient under ether, the difference in time for many operations will not be marked. I have several times done a double inguinal hernia operation under local anæsthesia in an hour. One objection is a real one. It is more trying for the surgeon to operate under local than under general anæsthesia. There is the additional mental strain of encouraging the patient to keep quiet and to keep up his courage. The coöperation of an intelligent patient is a great help. In any case we can arrange our day's work so that not too many operations under local anæsthesia are done at one sitting. Even if it is much more trying to do major operations without general anæsthesia, should we not sacrifice our personal comfort for the great advantages that accrue to the patient? The answer to that question will in large measure determine the field of usefulness of this procedure at the hands of each individual surgeon.

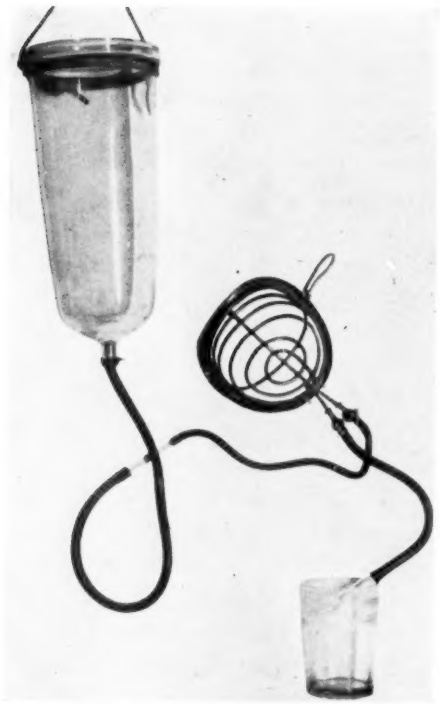

FIG. 1.—Apparatus for warming ether during inhalation.

DEVICE FOR WARMING ETHER DURING INHALATION

By J. E. Engstad, M.D.
of Minneapolis, Minn.

Construction.—An ordinary ether inhaler mask is reinforced with a coil of German wire tubing of No. 12 gauge. To both ends of the tubing a stop-cock is fitted, which aids in controlling the flow of the warm water through the tubing.

Experience has shown that water of a temperature of 121 degrees gives the best result.

A percolator or any receptacle capable of holding water is attached to one stop-cock with a rubber tube, and is elevated about 3 feet above the mask. To the other terminal a tube is fitted to lead the returned and cooled water to a basin.

Mechanical Advantages.—As an ordinary ether mask the spiral wire reinforcement adds strength and a framework for the gauze which is much to be desired in the ordinary inhalers.

Gases expand and the molecules are broken up as to the square of the temperature. It follows that the molecules, being smaller and less stable if warmed, enter the blood circulation with increased rapidity, are more diffusible, and more rapidly eliminated, than if the drug was inhaled and absorbed in a less diffusible form.

Amount of ether used is proportionatlly reduced. It is safe to state that at least one-third less is necessary for narcosis where heated gases are used than where the fumes are more or less atomized, instead of vaporized into the highest possible unstable molecules, which are rapidly absorbed.

If we minimize the loss of heat by supplying by mechanical means to balance the loss of energy by the expansion of gases, we to a certain extent obviate the chilling of the respiratory organs. The absorption of heat by the gases is to prevent the transmutation of innocuous germs in the respiratory tract into virulent ones by lowering the temperature. We thereby, in a marked degree, minimize the danger from ether pneumonia.

Furthermore, the gases being more diffusible when warmed, the quantity of the drug used is less and the destructive changes in the organs are reduced proportionally, which all tends to a more rapid and complete recovery.

RESULTS OBTAINED BY THE USE OF RADIUM IN THE TREATMENT OF CANCER OF THE UTERUS

AT THE UNIVERSITY OF PENNSYLVANIA HOSPITAL

By John G. Clark, M.D.

of Philadelphia, Pa.

The treatment of cancer of the uterus—that will-o'-the-wisp of surgery—has for the last three decades been a bone of contention as regards the best method of circumventing the growth by surgical methods. The various forms of hysterectomy have been thoroughly tested, beginning, first, with the simple vaginal method, a large series of cases thus treated having been reported from American and European clinics. The final summary of results, however, after a probationary five-year period, showed the treatment to be lacking in effectiveness, first, because it was applicable to only a relatively small number of cases, and, second, because the percentage of ultimate cures it yielded was lamentably small. Then came Schuchart's more radical vaginal hysterectomy, which, in the hands of a few experts, among the foremost of whom is Schauta, has given a larger rate of ultimate cures; it is, however, a very difficult operation, and is attended by a larger mortality, and is followed by serious vesical and ureteral sequelæ. Because of these objections, this method has received only limited approval from gynæcologists.

Following this, the extended or more radical abdominal method came into vogue, and until three years ago continental gynæcologic literature was replete with the reports of cases from many clinics; these contained both favorable and adverse criticism. About three years ago these reports suddenly ceased, to be almost entirely superseded by the consideration of radium and mesothorium as new and promising therapeutic agents.

This brief discussion of the rapid change of events in the surgical treatment of cancer leads to the inevitable conclusion that the surgical world is still very much at sea as regards the most effective method of dealing with this disease. A decided surgical advance has been made, but the progress is in no way commensurate with the effort that has been expended, for even in carefully selected cases the best series of radical operations still yields less than 50 per cent. of recoveries.

As a convincing evidence of the limitations of surgical applicability, we offer the results of our experience. In less than two years we have

treated 49 cases of inoperable cancer of the uterus with radium, and during the same period only 12 cases have been considered as within radically operative limits. During the preceding ten years the number of radical operations performed was about 60. In other words, for 50 cases subjected to operation, at least 250 have been abandoned as hopeless. This personal observation has convinced us, more than ever before, of our grave shortcomings as regards the surgical treatment of uterine cancer.

Although the radical operation has given the best ultimate statistics, so far as the number of permanent cures is concerned, experience has proved that beyond doubt, it is also attended with an unavoidably high primary death-rate; that it is followed by serious post-operative sequelæ which are difficult to cure, and that when these are irremediable, they leave our patients in a very wretched condition. Since the American Gynæcological Society so thoroughly reviewed this subject four years ago, I have found no reason to alter my views as expressed at that time after a study of my own cases. The conclusions then reached were as follows:

1. The operation, in expert hands, notwithstanding its high primary mortality, has given the greatest percentage of permanent cures of any therapeutic procedure thus far suggested for cancer of the cervix.

2. While the foregoing conclusion is true, the general adoption of the operation, in view of its dangers and difficulties, is not to be advised until the primary mortality can be reduced to a much lower percentage by a simplification or a perfection of details.

3. The abandonment of the extensive glandular dissection is justified, because this detail adds to the hazards and does not sufficiently increase the percentage of permanent cures.

4. The cardinal advantage of the operation lies, first, and above all, in the excision of an extensive cuff of vagina and the widest possible removal of the parametrial tissue.

5. There is no middle-of-the-road policy in cancer of the cervix. The surgeon would better perform a simple vaginal hysterectomy or a high amputation of the cervix with extensive cauterization than to attempt the radical operation if he is not prepared effectively to execute its details.

6. The earnest endeavor, by many specialists, with the improved ultimate cures in a few hands, offers the hope that a further simplification and perfection of details in this operation may yet make it more generally available.

The therapeutic problem involved in the successful treatment of carcinoma of the cervix is based upon the stage of invasion of the new-growth. The results of the radical operation have proved conclusively that, with very rare exceptions, the hopeless cases are those of the metastatic type. All the methods now being employed are, therefore, directed

toward the radical elimination of the local cervical and vaginal disease process. If the growth has invaded the parametrium to a point beyond the outer limits of the ureters, or if it has found lodgement in the iliac glands, the case must, with rare exception, be regarded as hopeless, so far as surgical extirpation is concerned. This statement may be challenged, but in that case the burden of proof falls upon the challenger. No operation as yet suggested has been more generally misapplied than has the so-called radical abdominal operation. This may be proved to one's own satisfaction by examining the specimen exhibited, as a rule, as the product of this operation. This criticism is directed not alone to the work of other surgeons, but applies with equal force to my own. There can be no more difficult surgical procedure than the radical operation for the removal of a cancerous uterus, for the efforts of the operator are impeded on all sides by insuperable limitations.

To attempt to compare the statistics of the various operators is a difficult or impossible task. In one clinic the greatest risks are taken, and an attempt is made to operate on hopeless cases in the belief that a dangerous hazard is always warranted, because thus an occasional brand may be snatched from the burning. Conversely, another surgeon, with less temerity, and possibly with better judgment, will operate only on cases that promise to reward his efforts and that are unmistakably within his surgical domain. The latter operator will, therefore, have fewer cases than the former, and, of course, his series will show a correspondingly higher rate of permanent cures. Then, too, the variation in skill of different surgeons plays an important rôle in the estimate of results. Because this skill varies so widely, and is so largely dependent upon the temperament and physical equipment of the surgeon, the standardization of the radical operation for cancer, whose degree of effectiveness is defined within the widest anatomic limits under the most hazardous of surgical liabilites, must reman forever upon shifting sands. In many operations the limited nature of the disease and its accessibility are such that more or less fixed principles of procedure may be evolved, and in these cases skill and judgment do not influence the operative results so profoundly.

In the anatomic division of cancer of the uterus this point may well be demonstrated, for in carcinoma of the fundus the statistics of various surgeons do not differ to any marked degree, because extirpation of the uterus generally suffices to give good results. So long as the growth is confined to the fundus, recurrence does not take place in more than 50 per cent. of cases, provided even a simple hysterectomy is performed. The rule, therefore, that calls for removal of the uterus

and its adnexæ may, in the hands of a mediocre operator, be productive of a mortality incidence and a permanent percentage of cures approaching closely those of his more skilled colleague.

We are all fairly well satisfied with the results of operation in cancer of the fundus, whereas no one regards the operative treatment of cancer of the cervix with any great degree of optimism. To attain a higher measure of success, some more efficient means than the scalpel must be employed. That this remedy has not as yet been discovered is shown by the fact that almost every surgeon who has made a special study of this question very properly advocates the same principle here as has been adopted in cancer of every other part of the body that is accessible to radical surgical measures. Notwithstanding the remarkably good results that have followed the use of radium, I still adhere to the dictum that the uterus and all possible adjacent tissue, if the growth is very limited in its extent, must be extirpated. Beyond this point, however, I have grown quite conservative. My first recession occurred eighteen years ago, after visiting Sänger's Clinic. I found that this very clever surgeon and clear thinker had even then abandoned hysterectomy as a palliative measure in widely extended cancer, on the ground that practically no hope of cure could be offered the patient, and that removal of the uterus actually intensified her subsequent suffering. Following a hysterectomy, if carcinomatous tissue is left in the parametrium, the patient's post-operative state is likely to be worse so far as pain is concerned, for it is usually severer and, therefore, more prolonged than if the uterus is allowed to remain *in situ*. With the removal of the uterus, the elastic broad ligaments and parametrium retract and cling closely to the pelvic wall, coming in contact with the large pelvic blood-vessels and the sacral plexus. If the growth remains in this situation the condition is infinitely more painful than if it is held in suspension away from the pelvic wall by the broad ligaments, and, therefore, more slowly reaches the periosteum and ganglionic roots.

The crux of the situation, therefore, as our experience has taught, is to attempt surgical measures only in the clearly operable cases, leaving the large remainder to secure relief from therapeutic efforts, which give as good or, as we now believe, even far better results from the use of radium.

In the inoperable cases, I believe the Percy cautery holds out a distinct hope; nevertheless, I do not share the great degree of optimism shown by the inventor of this method as regards the cases of wide-spread extension. In using the cautery, as in performing the radical operation, the anatomic barriers are the same, and I am firmly convinced that

its general adoption will be followed by even a larger number of serious and wretchedly disabling sequelæ, so far as the rectum, bladder and ureters are concerned. This cautery should be used only by the skilled specialists, for it is not safe in the hands of the novice. Even in skilled hands accidents are prone to occur in many instances. Moreover, one cannot get away from the fact that the Percy method is most radical, involving an abdominal section, ligation of the internal iliac arteries—a procedure that may be quite difficult in some cases—and the prolonged exposure of the patient to the slow desiccation of the tissues. This method must, therefore, be regarded as on trial, and it is to be hoped that its enthusiastic sponsor will publish a full account of cases up to date. We should know the mortality percentage and the degree of morbidity following the operation in order fairly to estimate its full value. Because of the fact that a sufficient quantity of radium was at our disposal at The University Hospital, we have followed this line of treatment almost exclusively, and we have had, therefore, but a limited experience with the desiccating method.

Under the best of clinical conditions, we are forced to throw into the surgical discard by far the largest proportion of cancer cases registered in our clinics. If we are still holding a very conservative opinion as to the final results following the Percy method, what, it may be asked, is our attitude toward the Röntgen ray treatment and the use of radio-active substances?

In this country the X-ray has not had sufficient trial to give it a place of even tentative value. To Bumm's Clinic, from which very favorable preliminary reports were issued, we looked for an elaboration of technic that would serve as a standard for comparison with radium and mesothorium. The Great War has, however, put an end to all investigation in the gynæcologic clinics of Germany, and it is only from the hospitals of the continent, where there is an abundance of material and also a willingness to risk much, so far as individual patients are concerned, to work out a theoretic principle, that we may expect authentic reports of hazardous novel procedures. The röntgenologist cannot be depended upon for convincing reports, for his cases are drawn from widely divergent sources, and too often the clinical diagnosis is accepted and no microscopic control attempted.

As to radium, I am convinced from our experience at the University Hospital that it offers the most helpful outlook of any remedy thus far presented in the palliative and occasionally the curative treatment of the border-line and inoperable cases. In the Gynæcologic Clinic of the University of Pennsylvania during the past two years, 44 cases of

carcinoma of the uterus, vagina, and urethra have been so treated. Practically all of these would, according to our past standards, have been classed as inoperable and, therefore, would inevitably have been doomed.

As regards the effect of radium when applied in too large amounts and too often, Schauta's experience is enlightening: In his first series of 13 patients, from 50 to 100 mgs. of radium were applied uninterruptedly for from three to eleven days, and repeated in similar dosage after an interval of from twelve to twenty-two days. His results were most disastrous: one patient died of pyonephrosis; 8 showed steady loss of weight, with diarrhœa, tenesmus, fever, vomiting, headache, and reduction in blood count. The autopsy findings showed severe necrosis and fistulæ with diphtheritic and purulent inflammations of the rectum and bladder, sigmoiditis, and ulcerative processes in the pelvic coils of the ileum. *One striking point, however, noted at the autopsies was that in not a single instance was a trace of local carcinoma found.* In the method of its application, however, the remedy proved far worse than the disease, but this investigator established beyond question that radium emanations were absolutely destructive to cancer cells.

In a second series of 11 cases the dosage was smaller and the interval of application shorter, but in spite of this some of the patients presented the group of disagreeable symptoms just noted, but in four a local cure was effected.

In his third series of cases the dosage was regulated as follows: From 30 to 50 mg. of radium, filtered through 1.1 mm. of gold, 1 mm. of platinum, and 0.75 mm. of brass, were applied in from 5 to 8 exposures of twelve hours each, at intervals of from one to several days; an interval of rest of three to four weeks was then allowed to elapse, followed by a second but shorter exposure, and in some cases, after another interval of two to three weeks, a third series of applications was employed.

Eleven patients were thus treated; of these, 3 were somewhat improved and the remaining 8 were apparently cured. In no instance were fistulæ or necrosis produced, and the weight and general condition of the patient showed marked improvement.

As an evidence of the wide-spread skepticism concerning these newer remedies, and in spite of this very favorable personal experience, Schauta declares that, although he will use radium in advanced cases, he will still continue to employ Schuchart's radical method of per-

forming vaginal hysterectomy in the clearly operable cases, reserving radium as a post-operative prophylactic agent.

With a less intensive method than that at first employed by Schauta, we have thus far had but one patient in whom a fistula developed; this followed a radical operation in which 50 mg. of radium were left within the vaginal cuff for eight hours, another application being made in six weeks. In this case there was no apparent retardation of the growth; on the contrary, within two months great sloughing holes appeared in the rectum and bladder. Whether these were caused by the radium or were due to the rapid growth of the carcinoma we were unable to determine. In practically every case radium has been applied for twenty-four hours, and the patient has usually returned home the next day. So far as any immediate effect is concerned, in no instance have we witnessed any untoward symptom beyond a fleeting degree of nausea, and this but rarely; only in one case did a high temperature develop, and this was in a case in which the Percy cautery had been applied extensively, and was followed by a twenty-four hour application of radium. In our series of cases there have been, with these two exceptions, no disagreeable effects. Fortunately, we have not had to pass through the experimental stage of this treatment but have profited by the mistakes of the early workers. Thus far we have found an 85 to 100 mg. dosage quite satisfactory. It is possible that still better results may be achieved by larger amounts. For information on this score, however, we must turn to Drs. Kelly and Burnam.

We have adhered strictly to one rule, namely, never to attempt an operation on any case that has been healed locally by radium. It appears to us a most unwise surgical policy to subject a patient to the grave hazards of a radical operation, after the radium has acted beneficially, in a fatuous attempt to secure still more effective results. With further experience we may modify this rule, but up to the present we have not seen the slightest evidence in favor of so apparently unwise a policy.

Radium, as is shown in our series of cases, is by no means a universal panacea for cancer, even when the growth is strictly localized. There is no way of determining which cases will be benefited by its use. There is beyond doubt a certain percentage—how small or how great we cannot tell from our experience—in which cancerous growths are not retarded by radiotherapy; indeed, occasionally it would appear that there is a positive acceleration of growth. That many cases show an astounding improvement and local cure cannot be gainsaid. In our series several instances occurred in which the results achieved were so

remarkable as to be almost incredible. Whether in these cases the fire is but smouldering and may break out sooner or later with renewed violence time alone will tell.

In the discussion of these cases the question of hospital economics must not be lost sight of. The length of stay in the hospital following a radical operation will average at least three weeks; whereas after the application of radium not more than three days will be required. When complications arise after radical operations they are usually serious, entailing much suffering. Such patients, on returning home, are likely to remain semi-invalids for several weeks, and when, as is frequently the case, there is a rapid continuation of the disease, they become a heavy burden to a poor family. In the comparison of statistics, this difference between the two classes of patients is greatly in favor of those treated by radium, a fact that tends to incline us strongly to the use of radium in border-line cases, which we formerly subjected to a radical operation.

It would also appear to be a self-evident fact that the post-operative effects of the Percy method must fall far short of those of the radium cases. I cannot here enter into a discussion of ultimate curative results, even though at present they may appear most promising, for we are on the very threshold of a therapeutic innovation that may, in the end, prove of less value in effecting a cure than the radical method of performing a hysterectomy.

Removal of the uterus in cases of cancer of the fundus has yielded such good results that I do not feel we are justified in taking any chances with radium, not even in the border-line cases. *Our attitude toward the cervical and fundal growths is diametrically opposite. In border-line cases of cancer of the cervix we invariably employ radium. In advanced cases of cancer of the fundus we invariably perform a hysterectomy.* A pessimistic view dominates our outlook in the surgical treatment of the cervical growths if the pathologic process is at all advanced, whereas fundal growths may be viewed with a cheerful optimism even when the cancerous process is extensive. As a palliative agent, we may assert with full assurance that we have never obtained results with any other method that have even approached in beneficence those secured by radium. The cloud, however, that hangs over the remedy is the danger of unbridled optimism.

The following three tables are appended, as they give the final results in the radical operation for cancer of the fundus and the palliative results in cases treated by radium during the last two years. A very close oversight is being kept of the radium cases, and we expect from time to time to give reports on all of these cases.

THE RADICAL OPERATION FOR CARCINOMA OF CERVIX

Operative deaths (peritonitis)	5
Died from continuance in 3 months	1
Died from continuance in 6 months	3
Died from continuance in 10 months	1
Died from continuance in 11 months	1
Died from continuance in 12 months	3
Died from continuance in 15 months	1
Died from continuance in 16 months	1
Died from continuance in 18 months	5
Died from continuance in 2 years	6
Unable to trace	10

Alive and no sign of continuance:

One year	2
One and one-half years	3
Three years	0
Four years	2
Five years	1
Six years	6
Seven years	1
Eight years	1
Total number of cases	53

POST-OPERATIVE SEQUELÆ

Suppuration of abdominal incision	8
Cystitis	4
Peritonitis (recovery)	3
Ureteral fistulæ	2
Vesical fistulæ	5
Phlebitis	1
Laceration of rectum (fistula)	1
Pleurisy	2
Rectovaginal fistula	2
Average stay in hospital	21 days at least

PANHYSTERECTOMY FOR CARCINOMA OF FUNDUS

Operative deaths (one patient died one week after operation from a general metastasis of chorioepithelioma. Death occurred from widespread involvement of the lungs with the malignant process. Other patient died from peritonitis)	2
Well over six years	5
Well over five years	1
Well over four years	1
Well over three and one-half years	2
Well over two and three-fourths years	2

Well over two years	2
Well over one year	1
Died from continuance of disease in 3 months	1
Died from continuance of disease in 7 months	1
Died from continuance of disease in 1 year	1
Died from continuance of disease in 3 years	1
Died from continuance of disease in 5 years	2
Died in two and one-half years from mastoid abscess (complete autopsy revealed no microscopic trace of cancer either in pelvis or in the abdominal lymph glands)	1
Unable to trace	3
Total number of cases	26

USE OF RADIUM IN INOPERABLE CANCER OF CERVIX, VAGINA AND URETHRA[1]

Deaths following treatment	0
Died from continuance in 1 month	4
Died from continuance in 2 months	1
Died from continuance in 3 months	1
Died from continuance in 4 months	1
Died from continuance in 6 months	1
Died from continuance in 7 months	1
Died from continuance in 8 months	1
Died from continuance in 9 months	1
Died from continuance in 10 months	1
Died from continuance in 11 months	1
Alive 22 months	2
Alive 21 months	1
Alive 16 months	1
Alive 14 months	1
Alive 12 months	2
Alive 11 months	1
Alive 10 months	1
Alive 9 months	1
Alive 7 months	5
Alive 6 months	2
Alive 5 months	1
Alive 4 months	5
Alive 3 months	4
Alive 2 months	15
Alive 1 month	4
Not traced	10
Total number of cases	69

[1] This table is a complete record of cases treated by radium up to the time of this paper going to print, September 15, 1916.

HISTORY OF PATIENT AFTER APPLICATION OF RADIUM

Relief of hemorrhage (complete)	34
Recurrence of hemorrhage in 3 weeks	1
Recurrence of hemorrhage in 4 weeks	1
Recurrence of hemorrhage in 6 weeks	1
Recurrence of hemorrhage in 2 months	1
Recurrence of hemorrhage in 3 months	1
Recurrence of hemorrhage in 4 months	2
Recurrence of hemorrhage in 8 months	1
Relief of pain (complete)	2
Relief of pain for 2 months	1
No relief of pain	18
No symptomatic relief	12
Local healing of ulcerative area (of this number, 2 died subsequently of internal metastasis)	26
Rapid extension of growth, coincident vesicovaginal and rectovaginal fistuale	5
Immediate untowards result	0

Average stay in hospital—about 3 days.

THE FOUR-POST FRACTURE BEDSTEAD

By Joseph Marshall Flint, M.D.
of New Haven

In a recent article describing my experiences in France with the treatment of fractures by the combined use of suspension and extension (Annals of Surgery, June, 1916), attention was called to some old mediæval four-posted beds which I found in one of the hospitals adjacent to our own. They adapted themselves so conveniently in providing points of support for the suspension and extension of fractured extremities and proved to be so comfortable and useful that I felt that they should be copied and placed upon the American market. It may be of interest to know that identical beds which we employed in France were purchased over one hundred and fifty years ago, when patients were afforded a certain amount of privacy and protection from draughts by curtains attached to the iron frames.

A bed of this type possesses many advantages. In the first place, the frames that are formed above and around the patient provide points of support to which suspension and extension appliances may be attached in any position (Fig. 1), giving either support or pull in any desired direction. The method of treating fractures in this way is fairly complicated and can only be followed readily when the attachments for these supports are convenient and available. Accordingly, it seemed desirable to provide a bed with the ordinary attachments and accessories that were found useful in most of the cases that could be so treated. It consists of a four-posted bed provided with adjustable traverses above and fixed crossbars at the head and foot, so that suspension and extension appliances may be attached at will. The bed is mounted on rollers, making it possible to move the patient easily. It is also provided with the mediæval type of springs which consist of interlacing slats of spring steel so curved that, when the patient lies upon it, the curve compensates for the unequal weight of the trunk and extremities, permitting the patient to rest in a horizontal plane. It is obvious that we have here the effect given by a fracture board, without, however, the discomforts of the latter, inasmuch as the springs yield to the movements of the patient. The bed is equipped with an inclined overhead trolley for the treatment of fractures of the femur, as well as an extension pulley which can be placed at any point at the foot of

the bed for purposes of extension. Several types of overhead supports equipped with helical springs and pulleys serve for the attachment of the suspension appliances and counterweights. The hooks, rings, and supporting hammocks which we found useful are also shown (Fig. 2).

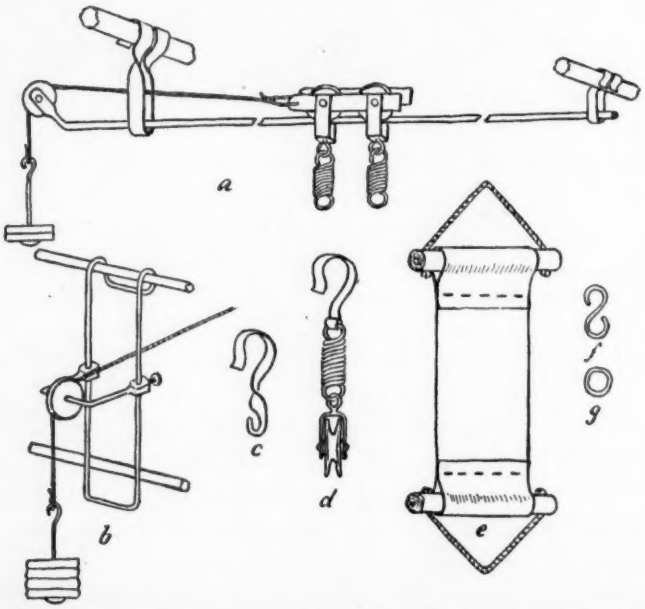

FIG. 2.—Details of the accessories. *a*, inclined trolley; *b*, extension pulley; *c*, hook; *d*, hook and pulley; *e*, hammock for support and the rotating mechanism; *f*, S-hook for making connections; *g*, ring for the attachment of ropes and hammocks.

It is unnecessary to go into detail at this time concerning the splints that can be used or the methods of treating fractures by this method. My own experience has been described in this Journal.[1] The article of Fauntleroy[2] on the appliances that have been devised and employed at the American Ambulance in Paris is worthy of careful study.

[1] Flint: ANNALS OF SURGERY, 1916.

[2] Fauntleroy: Report on the Medico-Military Aspects of the European War. Washington, 1915.

FIG. 1.—Fracture bed showing compensating springs, and the attachments for suspension and extension.

SUPERNUMERARY MUSCLE OF THE DORSUM OF THE HAND

EXTENSOR BREVIS DIGITI MEDII ET INDICIS: A RARE CAUSE OF DISABILITY IN A PIANIST

By Damon B. Pfeiffer, M.D.

of Philadelphia

The following case is reported not only because of its excessive rarity as an anatomical anomaly, but also because of its important practical bearing upon the occupation of the patient.

Mr. L. P., aged twenty-eight years, was referred to me by Dr. Vincent Lyon for an opinion as to the cause and treatment of a lump on the dorsum of his hand. The patient was a pianist and had been engaged in the study of this instrument for seventeen years. As long as ten years ago he had observed a small lump on the back of his right hand, which was situated in the angle between the extensor tendons of the index and middle fingers, its most prominent portion being about one inch below the level of the radiocarpal joint. This had increased gradually in size until at the time he was sent to me it was a quite conspicuous prominence when the fingers were held in extension. As he devoted himself more assiduously to practice, he observed that the lump would become quite sore after prolonged work, the soreness disappearing again after a period of rest. He noted also that the index and middle finger of the right hand seemed stiffer than the corresponding fingers of the left hand and, in fact, stiffer than any other two adjacent fingers of either hand, so that, in spite of the fact that he was right handed, it was more difficult to "trill" with these two fingers than with the others. For these reasons, which were serious because of the hindrance to his professional advancement, he sought relief.

On examination with the fingers flexed, there was a rather soft indefinable sense of fulness in the region indicated. Upon forced extension of the first or second fingers, or both, the prominence appeared and could be traced upward to where it seemed to blend with the annular ligament. It was tender to moderate pressure, which would give rise to an ache that lasted for a short time.

I attributed the condition to a synovitis involving the sheaths of the first and second extensor tendons and possibly affecting also the sheaths beneath the annular ligament. There was no evidence of previous local or general infection, but the patient

suggested the element of chronic trauma by saying that he ascribed the condition to playing in a forced and strained manner during his early practice. In view of the long series of recurrences upon exercise, with quiescence after rest, as well as the importance of bettering the condition, I concluded to lay bare the affected tissues in the hope of being able to resect inflamed or adherent structures. An X-ray taken previously showed that the bony structure of the hand presented no abnormalities.

Operation.—March 8, 1916, Presbyterian Hospital. A longitudinal incision was made directly over the mass. On opening the delicate deep fascia the structure of a muscle greeted my eyes. Its fleshy portion ran upward toward the annular ligament. Below, it sent off two tendons, the larger of which joined the radial aspect of the extensor tendon of the middle finger, while the smaller joined the ulnar aspect of the indicator tendon. Though there were two tendons there was apparently but one muscle belly. In view of the unexpected nature of the case, the lack of precedents in procedure, and the importance of doing nothing that might further impair the use of the fingers, after consultation with Dr. Lyon and cautious exploration of the muscle, the operation was terminated. Recovery was rapid and followed by a restoration to the former state.

The findings fully explain the nature of the case. A single-bellied extensor attached to two adjacent fingers would naturally interfere with the " trilling " movement, since extension of one finger would interfere with simultaneous flexion of the other and *vice versa,* though by the action of the more powerful long flexors and extensors the smaller muscle could be overpowered. The early stiffness and forced position to which he attributed the condition was rather a consequence than a cause of the anomaly, and the gradual increase in size was due to work hypertrophy of the muscle. Its antagonistic action, overpowered by stronger muscles, caused stiffness and soreness after exercise. It would seem justifiable, in the event of continued interference with function, to resect the muscle or perform tenotomy of the anomalous tendons, since the normal tendons were seen in their usual position and in a normal state of development.

In some respects this condition recalls the operation of Dr. Wm. S. Forbes,[1] first performed by him in 1857, which consisted in severing the accessory tendons of the ring finger in order to allow its extension unopposed by these bonds of union to the adjacent tendons. Mr. J. R. Zeckwer, whose interest in the subject is due particularly to the fact that his father was the first to advocate the procedure to musicians, states that some 10,000 operations of this kind were performed, with

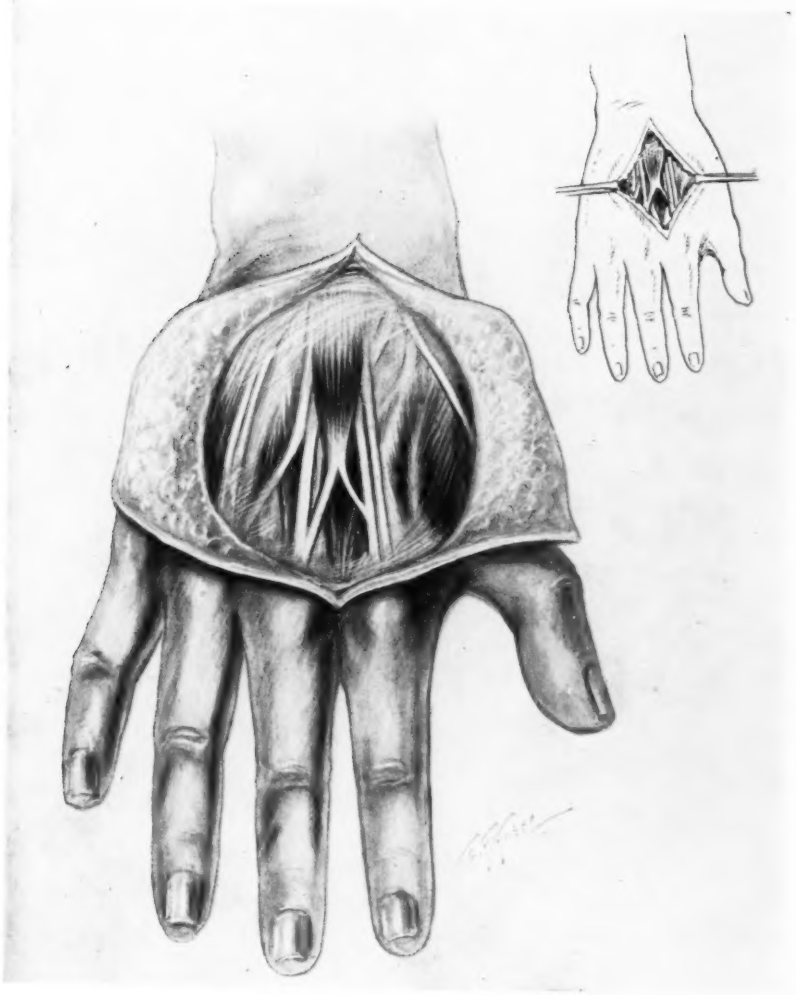

FIG. 1.—Extensor brevis medii digiti et indicis.

brilliant results in certain cases. It is not now thought necessary, though in some instances where restriction is marked it can doubtless be used with benefit.

The present case is a very rare anomaly. The only reference to what is apparently an exactly similar condition is by Gruber,[2] who reports one such instance in 600 dissections (1200 arms). This muscle arose within the sheath of the fourth compartment of the dorsocarpal ligament and from the base of the third metacarpal. In the present case the exact origin was not ascertained, owing to a desire not to inflict unnecessary injury. The insertions of the tendons in the two cases were the same.

Anomalies of various kinds of the extensor muscles and tendons of the hands, however, are not uncommon. Albin,[3] in 1758, reported and pictured an instance somewhat similar to the above, which he named the extensor brevis digitorum manus, and Gruber [4] has recorded some sort of varieties of the short extensor of the hand in 1.417 per cent. of 1200 dissections of the arm and hand. Such muscles are vestigial structures. Owen [5] has pointed out that in the *Lemuridæ* and *Quadrumana* "the homologue of the extensor indicis of man bifurcates, and sends a tendon both to the index and medius digit; the homologue of the extensor minimi digiti also splits and sends a tendon also to the annularis; so that while in man the index and minimus only have two extensor tendons, all four fingers have them in most *Quadrumana*."

Gruber [6] has shown that the *Orang Cynocephalus* and *Cebus apella* as a rule possess an extensor digiti indicis et medii, while MacAlister,[7] Humphrey,[8] and others have shown the normal existence of such short extensors of the digits in the unau, the ae, the two-toed ant-eater and the pangolin.

Ordinarily such variations would escape discovery. In the case reported it derived its importance from its bearing upon the occupation.

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THE IMPORTANCE OF THE PROPER DOSAGE OF SODIUM CITRATE IN BLOOD TRANSFUSION

By Richard Lewisohn, M.D., F.A.C.S.
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The use of a minimal dosage (0.2 per cent.) of sodium citrate as a simplified method for blood transfusion [1, 2] has given rise to a considerable discussion in our medical literature. The discussion has been running in two directions, diametrically opposed to each other. On the one hand, it has been claimed that sodium citrate is such a toxic drug that its use in the human being, especially in cases of lowered vitality (which exists in all cases requiring transfusion), is an extremely risky procedure. On the other hand, the claim has been made that 0.2 per cent. is too small a dose to safely prevent coagulation during the transfer of the blood.

I have so far refrained from entering into any discussion on these points. I think, however, that sufficient clinical experience has now been accumulated, not only by myself but by a great number of colleagues in different parts of the country, to consider these objections and review them critically.

Let us first take up the question of the toxicity of sodium citrate. There can be no doubt that sodium citrate is very toxic when introduced in large quantities into a human being. It is by no means an indifferent drug like sodium chloride or bicarbonate of soda, which can be administered in very large doses without any injurious effect.

Citrate of soda has been the anticoagulant par excellence in laboratory work for a good many years. Why had it not been used until lately in human blood transfusion? The reason for this is very obvious. In laboratory work the proportion of sodium citrate used was 1 per cent. It was a generally accepted idea that the blood would clot unless this 1 per cent. mixture of citrate and blood was adhered to.

I have shown in a series of animal experiments (*l.c.*) that it would have been impossible to use a 1 per cent. mixture of blood and sodium citrate in human blood transfusion, especially when large quantities of blood are needed. If we want to substitute older methods by a newer one, this newer method, in order to be generally adopted, must answer all the requirements which the older method fulfilled. Many cases in which blood transfusion is indicated require large dosages. Lindeman [3] stated only recently, that he gives as much as 1500 to 1800 c.c. at one time to many of his patients with his syringe-

cannula method. To give such quantities of blood mixed with 1 per cent. citrate would have been absolutely injurious to the patient. On the other hand, it is very obvious that the citrate method would have received scant consideration if we were obliged to limit its applicability to quantities of between 300 and 500 c.c., and if we were to face the possibility of serious injuries to our patients as soon as we would try to step outside of these very narrow limits. That my conclusions as to the toxicity of the 1 per cent. dose, though derived from a series of animal experiments only, hold good for the human being is very obvious from Brem's experience. Brem [4] administered 1 per cent. citrated blood, as suggested by Weil,[5] to nine patients, and came to the conclusion that " Weil's dose is toxic, dangerous and unnecessary."

For obvious reasons it is impossible to exactly fix the tolerance of the human body towards sodium citrate. I think, however, we can safely state that we can introduce 5 Gm. of sodium citrate into an adult without any risk of a toxic effect. The 0.2 per cent. dose, therefore, allows us to transfuse as much as 2500 c.c. of blood at a time, and that is more than anybody ever wants to take from a donor or introduce into the recipient. My experiences with citrate transfusion in children [6] are the best proof of the atoxicity of the citrate method and the 0.2 per cent. dose.

My personal experience with the citrate transfusion so far comprises 62 cases and 75 transfusions (the youngest patient being an infant ten days old). No sign of a toxic effect was observed in any of these cases. I have observed a chill following the transfusion in 10 per cent. of the cases. This percentage is absolutely identical with Lindeman's latest results (*l. c.*) (he formerly obtained nearly 30 per cent.[7]). If we do not get any more chills with the citrate method than Lindeman, who is using unmixed blood, gets, those chills can certainly not be caused by the mixture of the blood with an anticoagulant. I know from experience and observations of the older methods (vessel anastomosis, syringe method, etc.) that a certain percentage of chills will occur in any large series of transfusions, no matter what method is used. Furthermore, everybody familiar with transfusion work knows, that such a chill, usually not lasting more than a few minutes, does not interfere in any way with the clinical result of the transfusion.

We have had the good fortune to be able actually to compare the effects of citrated and unmixed blood. In a large series of cases which received repeated transfusions, two different methods were used at Mount Sinai Hospital—the citrate method and the Unger apparatus[8]—in order to compare the clinical results of citrated and uncitrated

blood. The citrated blood has in every instance proved clinically as beneficial as the unmixed blood. I have never seen a case in which any inferiority of the clinical value of citrated blood could be demonstrated.

It has been claimed by the opponents of the method (I think their number is rapidly decreasing) that citrate of soda might affect the microscopical elements of the blood (erythrocytes and leucocytes). I have repeatedly compared blood pictures of citrated and uncitrated blood. The citrated blood does not show any change from the normal blood picture. In fact, if one mixes up the different slides, it is impossible to say which were taken from the citrated blood.

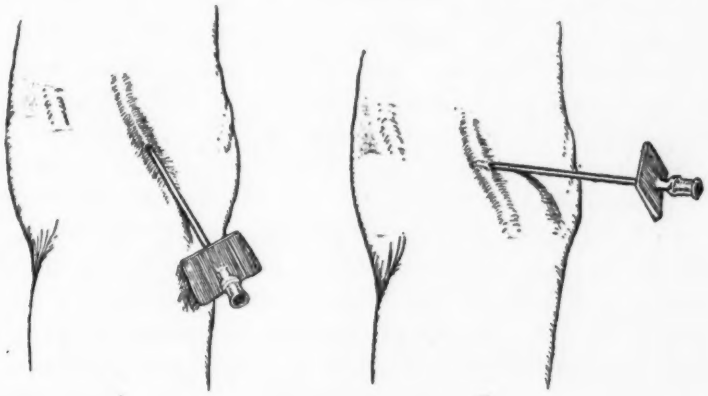
I have consulted Dr. Ottenberg in reference to the question of a possible interference of sodium citrate with the biological activity of the leucocytes. He pointed out to me that in the Wright opsonic determination, in which the phagocytic activity of the leucocytes is to be measured, leucocytes are collected in a 1½ to 2 per cent. sodium citrate solution, which is ten times as strong as the percentage used in transfusion.

As to the second question—is a 0.2 per cent. mixture of sodium citrate and blood really sufficient to prevent coagulation of the blood? If one mixes blood with sodium citrate at the rate of 0.1 per cent., such citrated blood will clot just as quickly as normal blood. If one adds a minute amount of citrate (5 cgm. of citrate to 100 c.c. of blood), thus making the percentage 0.15 per cent., such mixture will stay fluid for at least two days. It would be perfectly feasible to use a 0.15 per cent. mixture for the citrate method of blood transfusion. Such a mixture, however, would have to be made very accurately. The slightest error under 0.15 per cent. would cause rapid coagulation. For this reason the 0.2 per cent. mixture was suggested.

The great majority of the reports profess perfect satisfaction with the 0.2 per cent. dose. Brem, for instance (*l. c.*), reports that he has carried citrated blood (0.2 per cent.) as far as seventy miles before he injected the mixture, and that this percentage has given him perfect satisfaction. On the other hand, there have been reports published, stating that danger of clotting was considerable when blood and citrate were mixed at the rate of 0.2 per cent. and that slightly larger doses were advisable (Garbat,[9] 0.25 per cent.[3]; Carter,[10] 0.3 per cent.).*

* Agote (Buenos Ayres) sent me a few weeks ago a reprint of a paper entitled, "Nuevre procedimiento para la transfusión del sangre," published in the *Anales del Instituto modelo de clinicá medica*, Buenos Ayres, January, 1915. It is interesting to note, that we both came to the same conclusions independently of each other. Agote's dose is 0.25 per cent.

There is no objection to the use of a dose slightly larger than that originally recommended, as long as proper care is taken that the toxic level is not reached. On the other hand, a large clinical experience has shown that 0.2 per cent. is an absolutely safe percentage. Two considerations are of importance in connection with the question of the proper dose. It is very important that a large size needle be used when collecting the blood from the donor. The importance of this is obvious. Citrate and blood mix only after the blood has left the needle. The use of cannulæ with narrow lumen will not permit a free flow and the blood may clot before it mixes with the citrate solution. For the same reason care should be taken that the position of the cannula in the vein allows the blood to flow freely (Fig. 1).



A *B*

FIG. 1.—*A*, correct, *B*, faulty position of cannula in vein.

I have heard of some instances where the following mistake in figuring out the percentage was made. Two hundred cubic centimetres of blood were collected and mixed with 20 c.c. of 2 per cent. citrate solution. It is obvious that this represents a mixture below 0.2 per cent. The correct way to obtain the proper percentage would be to collect 180 c.c. of blood and mix this amount with 20 c.c. of the 2 per cent. stock solution.

I am sure that if these two points (proper position of cannula and proper mixture) are carefully considered, it will not be found necessary to increase the original dosage of 0.2 per cent., though 0.25 per cent. or even 0.3 per cent. can be used with perfect safety.

It seems hardly worth while discussing another argument, which has been advanced against this method. It has been stated that the 0.2 per cent. mixture, though possibly preventing coagulation of the

blood during the transfer, would not be sufficient to prevent formation of clots in the blood stream after its introduction into the recipient. In other words, it has been argued that the fixation of the minimal dose did not take into account the dilution in the blood stream of the recipient. This argument is so obviously without any scientific basis that it is not worth while dwelling on it for any length of time. It is obvious that all we have to do is to prevent coagulation during the transfer from donor to recipient. After the blood has once entered the circulation of the recipient, it does not need any anticoagulating drug; it then acts the same way as uncitrated blood.

Another important point might be discussed in this connection. How does the addition of an anticoagulant to the donor's blood affect the coagulation time of the recipient's blood? It might be argued theoretically, that the mixture of the blood with an anticoagulant might interfere with the coagulation time of the blood to such a degree that the citrate method would not be available in hemorrhagic diseases. The general applicability of the citrate method would thus be considerably curtailed. Weil (*l. c.*) has recorded the important observation that the coagulation time of the recipient's blood is shortened after the injection of citrated blood, and that the coagulation time of the recipient soon returns to its previous level. Ottenberg[11] has reported a most interesting study of the effects of a citrate transfusion on a hæmophiliac. After injection of 150 c. c. of citrated blood (0.2 per cent.) the coagulation time dropped within ten minutes from one hour and twenty minutes to seventeen minutes; after twenty-four hours the coagulation time had gone back to one hour and fifteen minutes and after nine days the coagulation time was one hour and thirty-five minutes. In other words, the coagulation time suddenly dropped most decidedly a very short time after a citrate transfusion and returned to its normal level within twenty-four hours. This observation tallies exactly with my findings.[2]

There is, however, a further observation in Dr. Ottenberg's paper, which, if confirmed, would represent a very important finding. Ottenberg injected 20 c.c. of a 3 per cent. citrate solution to patients. A sudden drop in the coagulation time occurred in the same manner referred to above. Forty-eight hours after the injection, however, the patient's coagulation time had nearly doubled (from one hour and thirty-five minutes to two hours and fifty minutes). It is impossible to draw any definite conclusions from this single observation in its present form. A possible objection to the conclusiveness of this experiment is the fact that pure citrate solution and not citrated blood was injected.

In an actual citrate transfusion the anticoagulating power of the citrate is practically absorbed in the endeavor to prevent coagulation of the blood, whereas if we inject pure citrate solution into the body, the whole quantity of the citrate is at liberty to exert its anticoagulating power on the blood of the recipient, thus lengthening the coagulation time considerably.

Ottenberg's interesting observations certainly deserve further study. It is very difficult to take correct notes on coagulation time in hæmophiliac and allied conditions. I agree with Ottenberg that only blood collected from the vein gives proper results. For obvious reasons it is hardly feasible to make thorough studies requiring frequent punctures of the veins of these patients. Practical experience certainly has shown in a large series of hemorrhagic diseases that the citrate method is just as beneficial as the transfusion of uncitrated blood. In fact, in cases of this kind where both methods were tried, the one has always proved as beneficial as the other.

I have grouped here together the more important arguments which have been brought forward against the application of the citrate method. It proves the real value of a new method that it can overcome in due time any objections which are thrown in its way. It is, however, a wrong principle to condemn the method, as has been done, on purely theoretical grounds. Anybody who still has theoretical objections should give the citrate method a thorough trial. I am sure that on this basis the citrate method will soon become the generally adopted method of blood transfusion, a position to which it is entitled on account of the utmost simplicity of technic and the perfect safety of its application.

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[4] Brem: Jour. Am. Med. Assn., 1916, lxvii, 190.
[5] Weil: Jour. Am. Med. Assn., 1915, lxiv, 425.
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[9] Garbat: Jour. Am. Med. Assn., 1916, lxvi, 1543.
[10] Carter: Southern Med. Jour., 1916, ix, 427.
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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting, Held May 10, 1916

The President, Dr. Charles N. Dowd, in the Chair

INTUSSUSCEPTION IN ADULT

Dr. Ransom S. Hooker presented a man, fifty-two years old, who was always well and strong, until one morning about a year and a half ago, when, on starting work, he began to have pain in his abdomen. This pain kept up all during the morning, but was not severe enough to prevent his keeping on with his work. After his lunch he suddenly had very acute abdominal pain, so severe he could not stand up, and he was taken to Bellevue Hospital about 3 P.M.; up to that time he had not vomited nor had his bowels moved. On reaching the hospital his temperature and blood were normal and his pulse 110. On examination his abdomen was rigid, somewhat distended, painful to pressure over all, and a mass was thought to have been felt in his right iliac region.

At operation, an incision was made through the right rectus and the abdominal cavity opened. There was considerable amount of bloody fluid and a large mass was found in the ileocæcal region, which was recognized as an intussusception. It was found impossible to reduce it, and, as part of the cæcum was necrotic, about two feet of the ileum and one foot of colon were resected and a side-to-side anastomosis made.

A thorough examination was made to ascertain the cause of the intussusception, but nothing was found except that the colon was very mobile. He made a perfect recovery and left the hospital in about three and a half weeks. His scar shows a firm wound with no signs of hernia.

Several times since his operation he has had attacks of acute abdominal pain. At each time he felt a lump, as he expressed it, which was about the size of a ball, but deep down, and by pressing on this lump it disappeared and the pain was immediately relieved.

PERFORATED DUODENAL ULCER

Dr. Fred. T. Van Beuren presented a man, aged thirty-five years, who was brought to the Volunteer Hospital on April 11, by the ambulance, at midnight. He had been working late at a bank and about 11 P.M. was suddenly seized with severe colicky pains in the epigastrium, accompanied by nausea and vomiting. The pains were so severe that an ambulance was summoned which brought him to the hospital, where he was put to bed on the Medical Service under expectant treatment. He had eaten nothing but crackers and milk for supper and had vomited repeatedly, but the pain persisted.

He said that his trouble began about two years ago, when he first began to have attacks of pain in the pit of the stomach. The pain was greatest to the right of median line, increased by outside pressure, and came on in irregular attacks with intervals when he was free from pain and discomfort. In such attacks, the pain usually made its appearance one to one and one-half hours after meals and lasted about two hours. Pain was more severe after eating meat and broths or hot soups. Occasionally he would vomit with the onset of pain. Vomitus is sour tasting and accompanied by burning sensation in the throat. He complained of having a good appetite but being afraid to eat on account of the pain. Eructation of gas follows the pain. He had noticed no blood in vomitus or stools.

When seen by the reporter, about seventeen hours after the onset of his attack, he looked exceedingly ill and was in evident, severe pain. His physical examination was negative, except for the abdomen, which was held tense and was rigid all over but especially in the right upper quadrant. Tenderness also was most marked here but extended over the entire abdomen and diaphragmatic respiration was decidedly limited. Liver and spleen could not be felt, but percussed normally and dulness could be elicited in the right but not in the left flank. No masses were felt. There was a trace of albumin and a few casts in the urine; temperature 102, pulse 100, respiration 28; no white blood-cell count had been made.

On opening the peritoneum, a considerable amount of cloudy fluid with some small particles of fibrin was forced out. This fluid had no odor and appeared to come chiefly from the right lumbar gutter. There were flakes of fibrin on the hepatic flexure of the colon and on the duodenum and all the intestines surrounding the area were reddened. A large fibrinous plaque, about 1 x 3 inches, covered part of the duodenum and the pyloric portion of the stomach and the right border of the great omentum. On raising the gall-bladder from the colon. to

which its fundus was adherent, the neck of the gall-bladder was lifted away from the adhesions binding it to the duodenum, and a ragged perforation about one-quarter inch in diameter was disclosed on the anterior wall, apparently of the duodenum; but as the pyloric vein could not be made out it is impossible to say definitely. From the perforation, gas and fluid issued. There was about two ounces of turbid fluid in the right lumbar gutter and a small amount in the pelvis. A careful examination of stomach and duodenum discovered no further ulcers. The peritoneal covering of intestines toward the left side of abdomen was apparently not involved.

Procedure.—An incision, six inches long, through outer border of right rectus muscle was made and retraction of the exposed edge of liver, gall-bladder and colon. Gauze was used to wall off the rest of abdominal cavity and the duodenum exposed by lifting up the liver and gall-bladder. A pack was placed over the perforation and the right lumbar gutter freed of fluid of aspiration.

A purse-string of fine chromic catgut with a fine curved needle was made to surround the perforation, and drawn tight, while the edges were inverted by an assistant. This closure was reinforced by a vertical running mattress suture of Pagenstecher, drawing anterior wall of duodenum against anterior wall of pylorus, and covered by fat tabs from lesser and greater omenta, drawn together across the suture line. When completed the repair seemed efficient. Its performance was difficult on account of the high position of the pylorus. After cleansing of the area all visible fluid was aspirated, pads removed and peritoneum and posterior sheaths closed by continuous catgut, anterior sheath by interrupted sutures of fine chromic and skin by silk. Dry dressing to binder.

He had a very smooth convalescence, not vomiting at all and having temperature normal on the sixth day, post-operative. His wound healed by primary union.

One point of interest was the extreme thirst he suffered during the first forty-eight hours, although he was retaining large amounts of fluid by rectum. It was then discovered that this was drachm to the pint saline, and when water by mouth and rectum were substituted for saline by rectum, his thirst was relieved. He has had no symptoms of gastric retention and no gastric or intestinal discomfort, except on the nineteenth to twentieth day, when an indiscretion in diet gave rise to moderate abdominal pain and diarrhœa. There was no sign of gross blood in the movements and a dose of castor oil with a return to soft diet for a few days relieved it.

SPLENECTOMY FOR HÆMOLYTIC JAUNDICE

DR. JAMES I. RUSSELL presented a young man, aged twenty years, who was admitted to the Medical Service of Roosevelt Hospital, from which he was transferred to the Second Surgical Service, July 6, 1915, suffering from hæmolytic jaundice with no symptoms other than occasional pains in upper right and left quadrants of the abdomen. His mother thinks he was a "little yellow" since birth, this became more marked at the age of five, from which time the jaundice has been practically of the same intensity. He feels perfectly well with the exception of an occasional dull ache in the upper abdomen. There is no itching of the skin, the stools and urine are normal in color. There has been no nausea, vomiting, weakness of crises such as accompany the acquired type of hæmolytic jaundice. His father and mother with six brothers and sisters are alive and well. There is no history of jaundice either in the immediate or remote relatives, though he tells me that those brothers and sisters who were born in Russia, as he was, are of darker skin than those born in this country. He is a well nourished young man, whose skin and conjunctivæ are distinctly jaundiced.

Physical examination.—Is negative except for a large spleen which extends four inches beyond the costal margin. The liver is not palpable. Upon admission temperature, pulse and respiration normal; weight 131 pounds; red blood-cells 5,216,000; H. B. 73 per cent.; white blood-cells 7600; polymorphonuclears 75 per cent.; basophiles 1 per cent.; lym phocytes 20 per cent.; large mononuclears 2 per cent.; transitionals 2 per cent.; anisocytosis; fragility, 0.45 per cent. saline, no hæmolysis; 0.4 per cent. saline, marked hæmolysis; 0.35 per cent. saline, complete hæmolysis. Vital stain 8 per cent. granular cells (reticulated reds). Wassermann negative. Urine negative. Blood culture negative.

Four days after admission to Surgical Service, he was given m. 10 adrenalin-chloride by hypodermic. Operation was performed a half hour later. Exploratory through the upper right rectus. Liver, gall-bladder and ducts appeared normal. Wound closed and a left upper rectus incision made. The spleen was very much enlarged, had contracted considerably (as demonstrated by surface markings) from the administration of the adrenalin-chloride. It was movable, there were but few adhesions, consequently but little bleeding, in delivering the spleen into the wound. The vessels were ligated individually and divided, the stump was then whipped over with catgut. The spleen weighed 1143 grammes (40). Temperature, which reached 102 on

the evening of the operation, reached normal on the fifth day and remained so throughout the convalescence, which was a smooth one.

Sixth day post operative: Red blood-cells 5,200,000; H. B. 85 per cent., an increase of 10 per cent.; white blood-cells 21,500; polymorphonuclears 83 per cent.; eosinophiles 4 per cent.; lymphocytes 13 per cent.; 18 normoblasts seen in counting 200 white blood-cells; anisocytosis, pœcilocytosis, achromia slight.

Fifteen days after operation: Fragility, 0.4 per cent. saline no hæmolysis; 0.35 per cent. saline slight hæmolysis; 0.15 per cent. saline still a few red blood-cells.

Six weeks after operation, hæmolysis begins, 0.45 per cent.; complete 0.3 per cent. The auto-agglutination test was not done. We have not, however, found it at Roosevelt to be as constant as Widal found it; which test is positive in his work in the acquired type and negative in the familiar type.

He was discharged from the hospital three weeks after operation, the jaundice having almost completely disappeared, wounds healing primarily.

TUBERCULOSIS OF KIDNEY

DR. RUSSELL presented a boy, aged eleven years, who has always been frail and delicate. No definite pulmonary process has at any time been demonstrable. In August, 1915, he had a little bleeding at urination from time to time; some frequency, getting up two or three times during the night. This has continued up to the time of admission into the hospital. About two months before coming to the hospital he began to complain of pain in the right lumbar region. The right kidney is palpable and tender to pressure. There is no tenderness over the left kidney and it is not palpable. He remained in the hospital for two weeks, during which time daily examinations of 24-hour specimen revealed red blood-cells and pus in varying amounts, but tubercle bacilli could not be demonstrated in the mixed urine nor could they from the catheterized specimen from the ureters.

Cystoscoped by Dr. Kilbane of which the following is an abstract:

Some congestion, pus flakes, and velvety appearance of mucous membrane of post-lateral left wall of bladder above trigone.

Trigone and ureter orifices negative—catheters pass readily to either pelvis. Urine from right kidney, normal, clear, contains no pus nor blood; left kidney, rapid continuous flow of light colored turbid urine containing much pus.

Microscopical examination of the catheterized specimens showed red blood-cells and pus from left side and normal from right.

Guinea-pigs inoculation from the urine from the left kidney was normal.

Was discharged and readmitted a month later.

Cystoscopy revealed right kidney functionating normally; left kidney still discharging pus and blood. Tubercle bacilli were found in the urine from left side, as it was on four or five successive days thereafter in the mixed urine.

Left nephrectomy with removal of the ureter through an intermuscular incision was done. The kidney showed no visible evidence of tuberculosis; the ureter was thickened in the upper part. Upon section of the kidney were two small cheesy areas of tuberculosis as proved by microscopical examination. Sections from the ureter also showed tuberculosis.

Convalescence was normal. Since the operation, 3 months ago, he has gained considerably in weight, has no more frequency or blood in urine, has been free from tubercle bacilli since soon after the operation.

This case was reported to emphasize the persistence with which one often has to pursue examinations to detect the tubercle bacilli, since they apparently only appear in showers from time to time. The pain was that of the renal reflex in which it was referred to the opposite side. The boy is unusually young for tuberculosis of the kidney. The advisability of removing the ureter at the primary operation, as this ureter showed tuberculosis, both macro- and microscopically.

RADICAL OPERATION FOR CARCINOMA OF BREAST. (WITH THE STEWART INCISION.)

Dr. Benj. T. Tilton said that the chief interest in the case presented by him lies in the method of incision. The case is a scirrhus carcinoma of the breast operated on two weeks ago to-morrow. The main point of the incision which is recommended by Dr. Stewart of Philadelphia is that the incision lies entirely upon the body and does not come up on the arm as in the usual incision. This is a great advantage on account of the fact that there is no possibility of contraction of the axilla following and also the scar is much less prominent. The post-operative comfort is very much better. After the operation the patient is able to move the arm perfectly well; in fact, it has not

been included in the dressing at all, and is, therefore, very much more comfortable.

The incision starts from the middle line on a level with the nipple and circumscribes the upper limit of the breast, including all the skin of the breast. It ends posteriorly at the same level over the latissimus dorsi muscle. The exposure of the muscles above is all done and the axilla dissection before the lower incision is made.

After having completed the dissection of the axillary space, the incision is completed by circumscribing the breast below, including the entire skin. Both pectoral muscles are removed. At the outer end of the incision a drainage tube is inserted for forty-eight hours.

The edges come together with much less tension than usual and the resulting line of suture is very much less unsightly.

Dr. John F. Erdman said that since September 28 or 29 he had removed breasts twenty-two times, nineteen of which were done by the Stewart incision. His experience has not been as beautiful as Dr. Tilton's in regard to the question of comfort. Now in every one of these twenty-two operations he has had more pain than in the ordinary incision. Then there is another thing, there is absolute adhesion of the flap to the wall and there would be more of a pull on the transverse scar than in the perpendicular one. The retraction of the skin flap during the dissection of the axilla is relatively as easy as any other type of operation. The operation is not possible in all growths of the breast, that is, in all malignancies.

The two, of these twenty-two operations, in which the Stewart incision was not used were cancers or malignancies of the breast occupying the lower quadrant at the lower and outer segment of the breast and pretty thoroughly involved, so that one could not dissect a flap without a great deal of skin graft. In these he made the old ordinary flap.

In two instances he had considerable amount of pocketing in the lower flap, because he had not put in sufficient drainage. If one uses a quarter inch tube or an eighth of an inch tube for the first thirty-six hours, there is no question about the drainage.

Personally, he liked the operation very much.

Dr. Wiener said that he had done the operation seven times since last July. The one strong characteristic of these cases was the lessened discomfort that these patients had. Another important advantage is the absence of swelling in the upper arm and forearm, which is so common with the old operation. This is almost absent in these cases. Also, there is no skin slough over the shoulder, which took five or six

weeks to heal. The transverse incision would occasionally give a small marginal necrosis but a very small one.

MAJOR SURGERY UNDER MINOR ANÆSTHESIA

DR. JOS. WIENER read a paper with the above title, for which see page 589.

DR. S. C. MILLIKEN said that a year ago in April he saw Dr. Mitchell in Washington do a two-hour operation on an old fracture of the clavicle where the inner fragment was pressing on the brachial plexus and causing pain. This operation was on a man of about sixty-six years. He used what he said was one-tenth of one per cent. of cocaine with one to ten-thousandths adrenalin. Apparently there was no discomfort to the patient during that long and very tedious operation. It was very difficult to shell out the callus. He made a tongue and groove thing on the ends of the bones, and a very beautiful reduction. The procedure seemed very brilliant. Since then he had used that method in quite a number of cases.

In hernia cases it is a very nice procedure, but the only part that he had not been able to make painless is the exploration of the inner side of the abdomen. In feeling to see if there is a second sac or if there is any need to feel inside the patient, the patient always complains when the exploring finger comes down to the bladder in feeling into the pelvis.

In double operations the local anæsthetic should be resterilized after the first operation. He recently tried a double hernia at one sitting on an old man with a severe case of bronchitis. The left side was infected. Perhaps if they had resterilized the cocaine the infection might have been avoided.

A week ago last night a man came in with a ten days' intestinal obstruction. He had a large right hernia which was a recurrence, and was irreducible. He was continually hiccoughing, his skin was cold and clammy and he had a very small pulse. The hernia was not entirely reducible, because the abdominal wall was so tense that contents could not be held back. An incision was made with the idea of finding out what was the trouble; running the hand into the pelvis there was found a carcinoma causing the obstruction about three inches above the pelvic floor, the small intestine was adherent to the carcinoma. The sigmoid was drawn out and drained. There was no pain except while the hand was exploring around in the pelvis. He died five days later of asthenia without any local complications.

DR. TILTON said that cocaine had practically had its day as a local anæsthetic in general surgery. Novocaine has great advantages, the chief one being this—the amount of novocaine that can be employed is practically unlimited.

First the use of novocaine in combination with general anæsthesia is most satisfactory in gall-bladder operations. The amount of ether necessary to get relaxation of the abdominal wall is very much less because of the anæsthetic effect of the novocaine on the parietal peritoneum. One can get along with gas and oxygen and practically no ether.

DR. KARL CONNELL said that local and other minor methods of anæsthesia for major surgery have done great service in developing the technic of operating. Minor anæsthesia has trained the surgeon in fast work, sharp cutting and the avoidance of traction and pressure on tissue. By competition it has undoubtedly improved the quality of general anæsthesia. It would be unkind to say that this has been the greatest service of local anæsthesia to major surgery. Yet, when one averages the results of the more dangerous methods, such as spinal nerve block, with those of efficient ether anæsthesia, there can be no question as to the average choice. Even local block anæsthesia, when applicable to major operations, has a value below that of general anæsthesia. When one considers the psychic strain on patient and on surgeon, the increased time and difficulty of operation, the systemic intoxication, and the operative sequelæ, such as pneumonia, that one occasionally encounters under local anæsthesia, the actual field for minor anæsthesia in major surgery is limited. Development in anæsthesia will take place along the line of more efficiently administered general anæsthetic, properly selected and graded in depth to block the centripetal stimuli of the operation in hand.

BOOK REVIEWS

TREATISE ON FRACTURES. By JOHN B. ROBERTS, A.M., M.D., and JAMES A. KELLY, A.M., M.D. With 909 illustrations, radiograms, drawings and photographs. Philadelphia and London: J. B. Lippincott Company, 1916.

As stated in the preface, the purpose of the authors of this work is to present a lucid view of the subject of fractures in the light of recent discoveries, to point out an accurate scientific procedure according to the character of individual injuries, and to urge the general practitioner, as well as the surgical specialist, to the study of methods, operative or non-operative, with augury of propitious result.

From a careful analysis of the pages of this volume, it may be vouchsafed that the authors have not only attained their purpose, but that they have also added to the literature of fractures a standard and authoritative guide embracing the results of vast practical experience, careful thought, sound judgment and the painstaking attention to details involved in the accurate recording of those observations which emphasize and clarify methods and results.

The arrangement of the text is simple and concise; there are twenty-nine chapters in all, the first of which is most comprehensive and devoted to so-called general considerations. In this are included statistics, etiology, the varieties and classification of fractures, symptomatology, and diagnosis, together with some observations on the value and function of the X-ray. The same chapter includes the process of fracture repair, delayed, vicious and non-union, the complications of fractures, a description of epiphysial separations, and a comparison of the results of non-operative and operative treatment. In the same section are well described the various methods of reduction and immobilization, together with the many varieties of retention and traction apparatus and the indications for their use.

Chapter II is given to a consideration of the operative treatment of closed fractures. In this are clearly set forth the indications for and against open interference and the technic of operative repair with and without internal fixation. The several mechanical appliances for

retaining the fragments in proper position are fully discussed with special detailed reference to the metallic plates of Lane and Sherman and the living bone graft.

Beginning with fractures of the cranium, the various regions of the body are next considered in their proper order. This regional presentation of the subject comprises twenty-five chapters, in each of which are accurately recorded statistics, etiology, surgical anatomy and the several factors pertinent to diagnosis and appropriate methods of treatment.

The volume is concluded with sections given to the consideration of birth and gun-shot fractures.

The illustrations are excellent and abundant. Many photographs, skiagrams and anatomic drawings, over nine hundred in number, serve to emphasize every phase of the subject. A complete index is appended. A study of these pages is both profitable and a pleasure. The teachings are sound, modern, practical and conservative. We commend it not only to the student and general practitioner, but also to the hospital surgeon who aspires to give his fracture patients results which are better and possible of attainment in shorter periods of time than they have been in the past.

WALTER A. SHERWOOD.

A TEXT-BOOK OF FRACTURES AND DISLOCATIONS, WITH SPECIAL REFERENCE TO THEIR PATHOLOGY, DIAGNOSIS AND TREATMENT. By KELLOGG SPEED, M.D., Attending Surgeon, Cook County and Provident Hospitals, Chicago, Ill. Octavo, 888 pages, with 656 engravings. Philadelphia and New York: Lea & Febiger, 1916.

Within the past year American surgeons have made notable and valuable contributions to the literature of fractures and the surgical affections of bones and joints in general. The new works of Roberts and Kelly, of Preston, Albee and a revised edition of Scudder, together with the volume under present consideration, all bear striking evidence of the increased interest which has been aroused and the progress made in this important branch of the science of surgery.

In the preparation of this work, while the author has made use of the literature on the subject of fractures and dislocations, much of the clinical and all of the statistical material has been obtained from the records of the Cook County Hospital, Chicago, where opportunity has been afforded for the observation and study of many thousands of cases.

The arrangement of the text comprises twenty-eight chapters. The first three sections are especially noteworthy; they are given to a consideration of bone regeneration and transplantation, the etiology and general mechanism of fractures and their pathology, a basic knowledge of which is just as essential for proper interpretation and treatment as in any other field of medical or surgical science.

Separate chapters are given to the general considerations of both fractures and dislocations; in their regional arrangement, however, the dislocations are discussed with fractures according to the bone or joint involved.

The operative treatment of open and closed fractures is fully and ably presented. The discussion of the methods of reduction, extension and immobilization is excellent.

The text is profusely illustrated with reproductions of photographs and line drawings. The latter are made from careful tracings of röntgenograms, each of which represents an actual case.

The work as a whole is complete and in thorough accord with the best modern teaching. Its pages contain many original ideas and suggestions.

WALTER A. SHERWOOD.

DISEASES OF THE NOSE AND THROAT, COMPRISING AFFECTIONS OF THE TRACHEA AND ŒSOPHAGUS. A Text-book for Students and Practitioners. By SIR ST. CLAIR THOMSON, M.D. Second Edition, with 22 plates and 337 figures in the text. Cassell and Company, Ltd., London, New York, Toronto and Melbourne, 1916. Roy. 8vo. pp. XVI. 858.

The author first presents a short chapter on the embryology and physiology of the nose and throat, with general remarks on methods of examination, general symptoms and treatment and the unusual conditions, as well as the usual ones, affecting the risk of operative treatment. One hundred and fifty pages are given to general and special considerations, including the symptoms and treatment, of the diseases of the nose. The same amount of space is devoted to the accessory sinuses of the nose. Then follows a short chapter on hypertrophy of the nasopharyngeal tonsil, tumors of the nasopharynx and postnasal catarrh. One hundred pages are given to the consideration of the numerous affections of the oropharynx and the tonsils, both acute and chronic. A similar space is devoted to diseases of the larynx. Twenty pages are given to diseases of the trachea and œsophagus. A special chapter on

the chronic infective diseases (lupus, tuberculosis, syphilis, glanders, leprosy, sclerosis and actinomycosis) of the upper air-passages fills a hundred pages. The manifestations of the acute specific fevers (measles, scarlatina, variola, varicella, pertussis, typhoid, influenza and diphtheria) occupy about twenty-five pages. The next part of the book is devoted to some general affections of the nose and throat, including gout, rheumatism, myxœdema, acromegaly, angio-neurotic œdema, herpes, pemphigus, exudative erythema, foreign bodies in the air and food passages, median cervical cysts and fistulæ and mimicry of disease. The next and final part of the book describes some of the more extensive and radical operative procedures on the nose and larynx. Formulæ and an exhaustive index complete the book.

It will be seen by the scope of the work which the above summary of its contents is intended to exhibit, that this is a thoroughgoing treatise in which the field covered by the title has been thoroughly worked out. The reviewer would be pleased if he could give some idea of the author's style which carries much in comparatively few words and conveys to the reader the earnest convictions of the writer from an evidently wide clinical experience and enthusiastic study of the literature of the subject. Very little of importance has been passed by without some, and usually helpful, comment. While not encyclopædic, the book is inclusive and satisfying. WILLIAM C. BRAISLIN.

DISEASES OF THE SPINAL CORD AND ITS MEMBRANES. By CHARLES A. ELSBERG. Saunders Co. 8vo. pp. 330.

DR. Elsberg's work is noticeably free from the atmosphere of "compilation" which forms a distinct halo around so many works in medicine and surgery. This recent contribution to the surgery of the spinal region presents a striking contrast, in that it is largely made up of the author's actual experiences in the various conditions portrayed; from inspection and diagnosis, through operation and post-operative treatment until the patient is discharged, thus giving it a unique value. As it correctly states in the preface, those underlying principles which have stood the test of time are incorporated, as in any science, the fundamental facts already demonstrated are always employed in widening our horizon toward bigger basic truths. However, the work in question distinguishes itself not only in its particular field but as a type of surgical writing, the style of which is indeed none too apparent at the present time.

The book must be commended for its practical size and lack of great bulk making it convenient for both student and practitioner and for the

absence in its text of superfluous, extraneous and irrelevant material. Particular note should be made of the logical order of arrangement of the various chapters and the admirable system of indexing, which is clear, concise and time saving. The illustrations are especially valuable on account of their anatomic and pathologic accuracy, their generous variety and the many excellent roentgenograms included.

It fills a long-felt need in neurologic surgery for competent and constructive work in this field.

The book is divided into three parts with each division complete in its particular phase covered, thus making an important reference for any particular branch of the subject when a complete survey is not desired.

Part I.—Incorporates the surgical anatomy of the vertebral column and the spinal cord, the normal and pathological physiology of the spinal cord, the localization of motor, sensory and reflex functions in the different segments, symptomatology of spinal disease, the symptoms of spinal disease at different levels of the cord, methods of examination, the use of the X-ray here and the differential diagnosis of surgical spinal lesions.

In taking up the anatomy of the vertebral column a complete résumé is not attempted, the author merely refreshes some more prominent facts and emphasizes the salient points of the osseous and muscular coverings of the cord from the surgical side.

The membranes of the cord are briefly discussed with respect to their anatomical relation to the cord and nerve roots, their formation of surgical landmarks, and the importance of the subarachnoid space as a cistern for cerebrospinal fluid.

The surgical value of a thorough knowledge of the anatomic variations in the relation between cord and vertebræ at different levels of the spine, is clearly and briefly stated. In touching on the blood supply and main fiber tracts of the cord, the vessels are covered in a general way to emphasize the high vascularity of this region and to indicate certain incisions of choice when working near them.

A very practical table of the main fibre tracts is represented.

The physiology of the cord serves to refresh and summarize those facts of primary importance which must always be in play when considering spinal lesions from any standpoint.

Variations in symptoms are explained with respect to changes in anatomy at different levels as well as results following partial and complete damage to various structures involved.

Highly interesting observations have been made by the author concerning the sensitiveness of the cord and its coverings. This section embraces a table explaining the segmentary localization of the muscles

with their functions included and must necessarily be mastered by any one attempting to correctly interpret abnormalities of those functions when due to spinal origin.

In recording the symptomatology of various lesions a careful analysis has been made to show the points of contrast between those of intramedullary and those of extramedullary origin, and stress is placed upon a proper recognition of the *sequence* of symptoms in order that a wise judgment may be formed when finally summing up a given condition.

With completeness and system a chapter describes the method of examination followed by the author, including a timely reminder that it is only by careful, thorough and repeated examinations that a correct diagnosis can be made and the exact localization of a spinal lesion be determined and the advisability of taking nothing for granted.

In the chapter on Roentgen-ray, the importance of this procedure is emphasized for every patient before operative intervention, not only to substantiate but in many instances to aid in ruling out a particular condition, and, further, it is wisely cited that the roentgenogram will in a large number of patients reveal the nature of the process which is causing the spinal symptoms and will offer information which may contraindicate operation, while in others the picture makes it imperative. To correctly read the findings in these X-rays, the well-known fact is repeated that the observer must have had considerable experience, including a study of the normal vertebral column.

Part I concludes by summarizing the main points concerning differential diagnosis, not only between lesions of cerebral and spinal origin, but also those which may be successfully relieved by surgery and the other class which by their nature, extent and location, makes any thought of operation an absurdity. A point noted and never to be lost sight of is the fact that a patient may have more than one condition of the spine at the same time, most frequently a luetic condition associated with some other process; tumor or what not.

Part II first treats of lumbar puncture and makes it clear that this operation is in no sense a formidable procedure and should in the rarest instances be attended by untoward results if a few fundamental principles governing the technic are observed. The wide and important range of conditions in which this may and should be advantageously employed has not had sufficient emphasis during recent years. This chapter is complete and should give any reliable man confidence to resort to the operation whenever indication arises.

The relative merits of hemi and complete laminectomy are discussed by Dr. Elsberg with the result that the complete operation is much

to be preferred and the doubtful benefits of the hemi laminectomy exist only when no exploration is necessary and when the operator wishes to divide nerve roots on but one side. The detailed technic of the author's method of laminectomy is given, including position of patient, anæsthesia, preparation and sterilization of operative field, and removal of bone until cord is exposed.

The special instruments adapted to this work are not only mentioned as each step is described, but they are also pictured, making the various stages of exposure much easier to comprehend and more readily visualized as one digests the text.

The possible dangers in different regions and the best plan of meeting these exigencies when they arise are clearly set forth.

Rhizotomy is broadly presented and after a careful analysis of the experience at large as well as his own, the author impresses the fact that it is not to be carried out for all classes of root pains, as a general panacea, but in selected patients only, and with the judgment based on a wide experience as the proper criterion for decision. A brief review including technic is made of the comparatively new operation of division of the antero-lateral tracts for pain relief. The author concludes that further experience must prove its usefulness as well as its limitations. The method of aspiration and incision of the cord is also given here.

A general consideration of the contraindications as well as the indications for laminectomy is given due emphasis. It is succinctly pointed out that the dangers should be relatively very slight when the operation is performed by the surgeon experienced in this line of work.

While the various forms of spina bifida have not in the main been attended by particularly brilliant results surgically, a section devoted to this unfortunate malformation may stimulate others to investigate and advance our present knowledge of the subject.

The material on abnormalities and diseases of the spinal vessels is graphically supplemented by the artist's drawings and the essential points in correctly recognizing and differentiating these vascular conditions are given.

One of the most important chapters of this work is that pertaining to injuries of the vertebræ, cord and nerve roots, because it is this class of traumatic spinal conditions which is most commonly encountered by the general surgeon.

The section on tumors of the vertebral column, spinal cord and membranes is covered with the thoroughness to which this part of the work is properly entitled; including many splendid illustrations demon-

strating operative procedures involving them and showing the particular lesions at different levels of the cord.

Other pathologic conditions here considered are, inflammatory processes of the membranes, abscess of the cord, spinal complications of Pott's disease and other less common diseases of the vertebral column, making the book as complete as it is practical.

It is a guide that should prove valuable to both physician and surgeon and surely would be a distinct asset to every medical library.

HORACE G. DUNHAM.

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